Central Valley Regional Water Quality Control Board

Draft San Joaquin River Basin Diazinon and Chlorpyrifos Total Maximum Daily Load Report July 23, 2002

Workshop Agenda

- Introduction and Welcome
- TMDL and Basin Plan Amendment timeline
- Regulatory Background and Problem Statement
- Numeric Target
- Source Analysis
- Load Allocation and Linkage Analysis
- Implementation Framework
- Questions and Answers

Introduction

Les Grober

Introduction

- Meeting logistics
- Time constraints
- Questions and comments at the end
- Introduction of Regional Board staff

TMDL & Basin Plan Amendment Timeline

Workshop on Draft TMDL & Implementation Framework	July 2002
Workshop on Draft Program of Implementation	August/ September 2002
Draft Staff Report to Peer Review	September/ October 2002
Public Review Draft	November 2002
Board Workshops/Revised Drafts	December 2002/ March 2003
Board Hearing	June 2003
State Board	October 2003
Office of Administrative Law	December 2003
U.S. EPA	March 2004

Regulatory Background and Problem Statement

Shakoora Azimi

Regulatory Background

- Federal Clean Water Act
- Porter-Cologne Water Quality Control Act

Regulatory Background

- Federal Clean Water Act
  - Requires States to identify waterbodies not attaining water quality standards
  - Set priorities for addressing pollutant problems
  - Establish a TMDL for each identified waterbody

Regulatory Background

- TMDL = LC = Ó WLA + Ó LA + MOS

LC = Loading Capacity

LA = Load Allocations

WLA = Wasteload Allocations

MOS = Margin of Safety

Regulatory Background

- Porter-Cologne Water Quality Control Act
  - Establishes responsibilities and authorities of the State Water Resources Control Board and Regional Water Quality Control Boards
  - Water Quality Objectives
  - Program of Implementation
  - Basin Plan

Regulatory Background

Total Maximum Daily Load (TMDL)

- Describes maximum allowable load for a pollutant in a waterbody, allocates the load among sources
- Required elements described in 40 CFR section 130

TMDL Scope

- Diazinon and Chlorpyrifos: organophosphorus pesticide, broad spectrum, urban and agricultural pest control

- Lower San Joaquin River listed on the Clean Water Act § 303(d) list as impaired by diazinon and chlorpyrifos (TMDL Required)

TMDL Draft Report Overview

- **Chapter 1 Problem Statement**

  Background information and a description of the Impairment

- **Chapter 2 Numeric Targets**

  In-stream quantitative water quality goals for the lower San Joaquin River

- **Chapter 3 Source Analysis**

  Identification and description of sources of diazinon and chlorpyrifos

- **Chapter 4 Linkage Analysis**

  Link between water quality target and the load of diazinon and chlorpyrifos

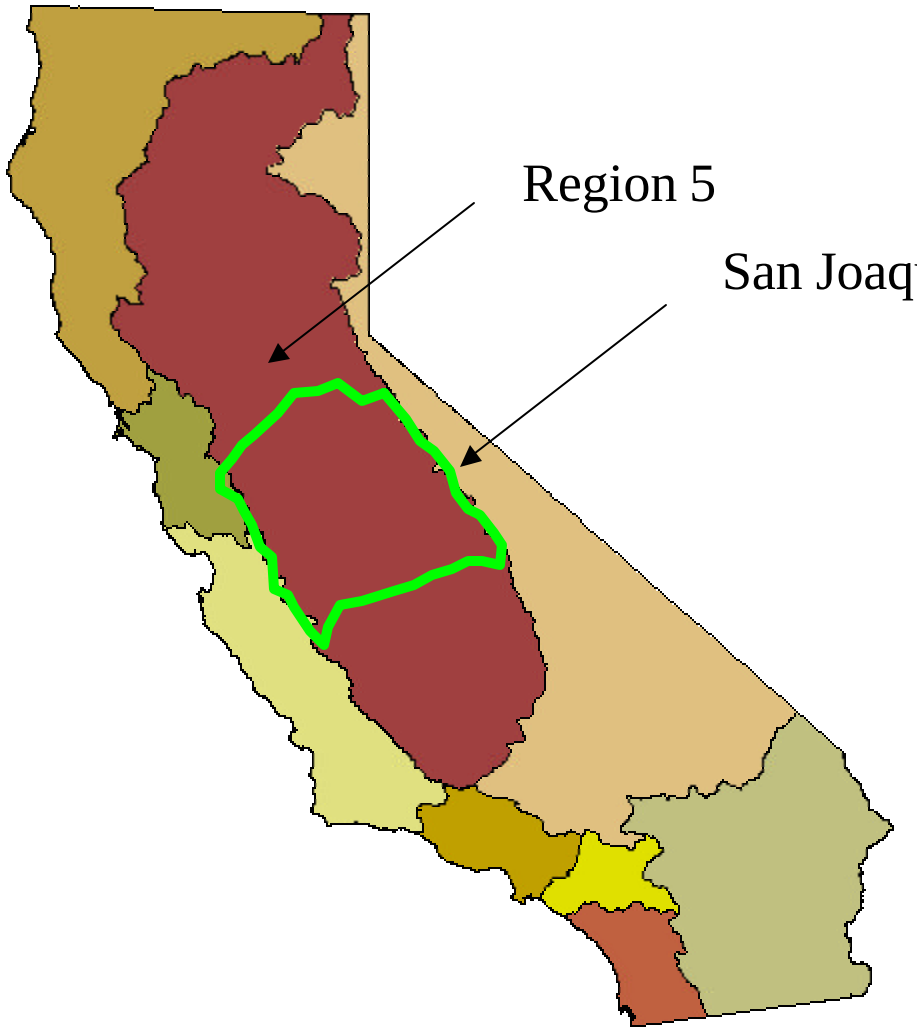
- **Chapter 5 Load Allocations**

  Allocation of allowable load among the sources

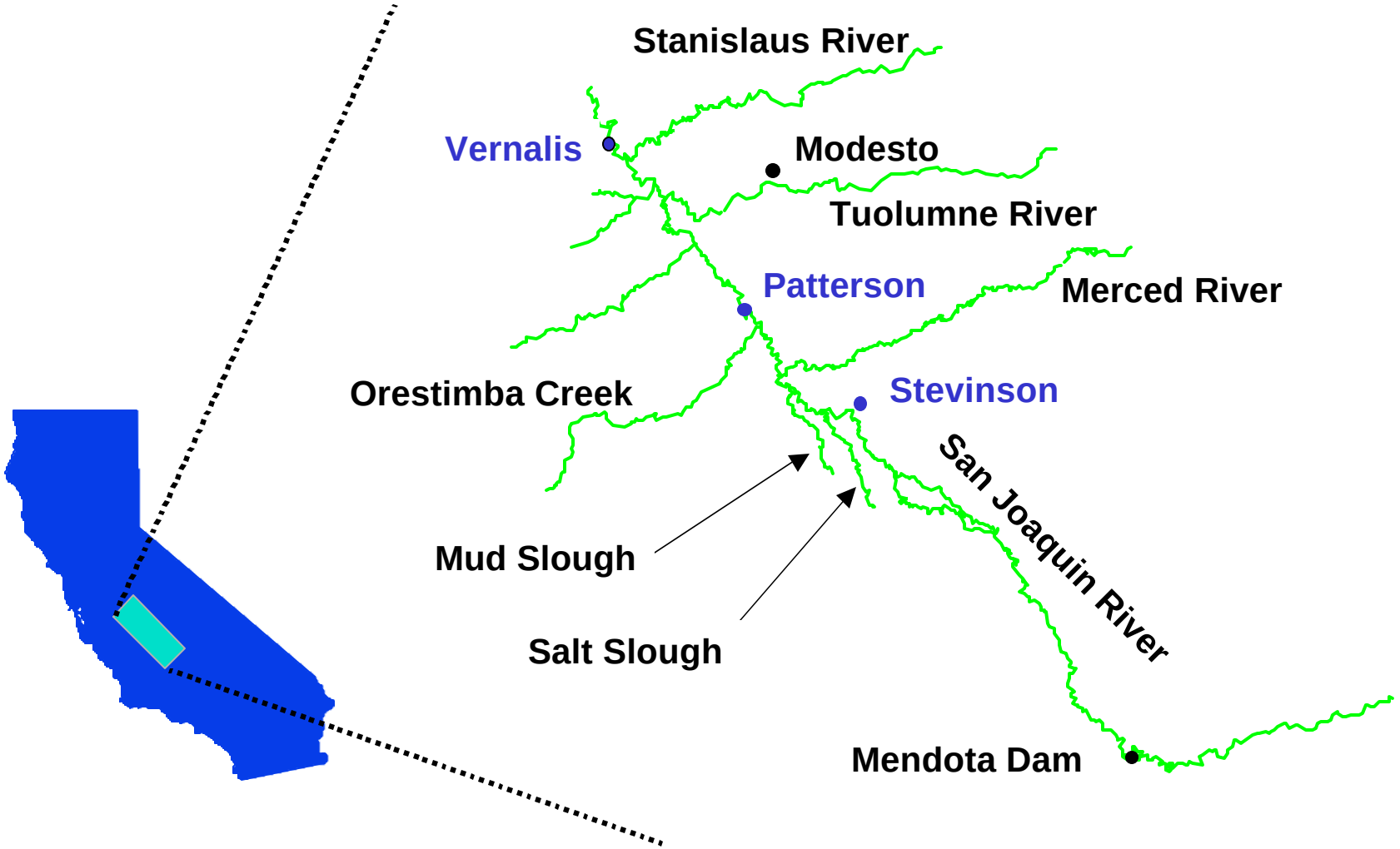
Problem Statement

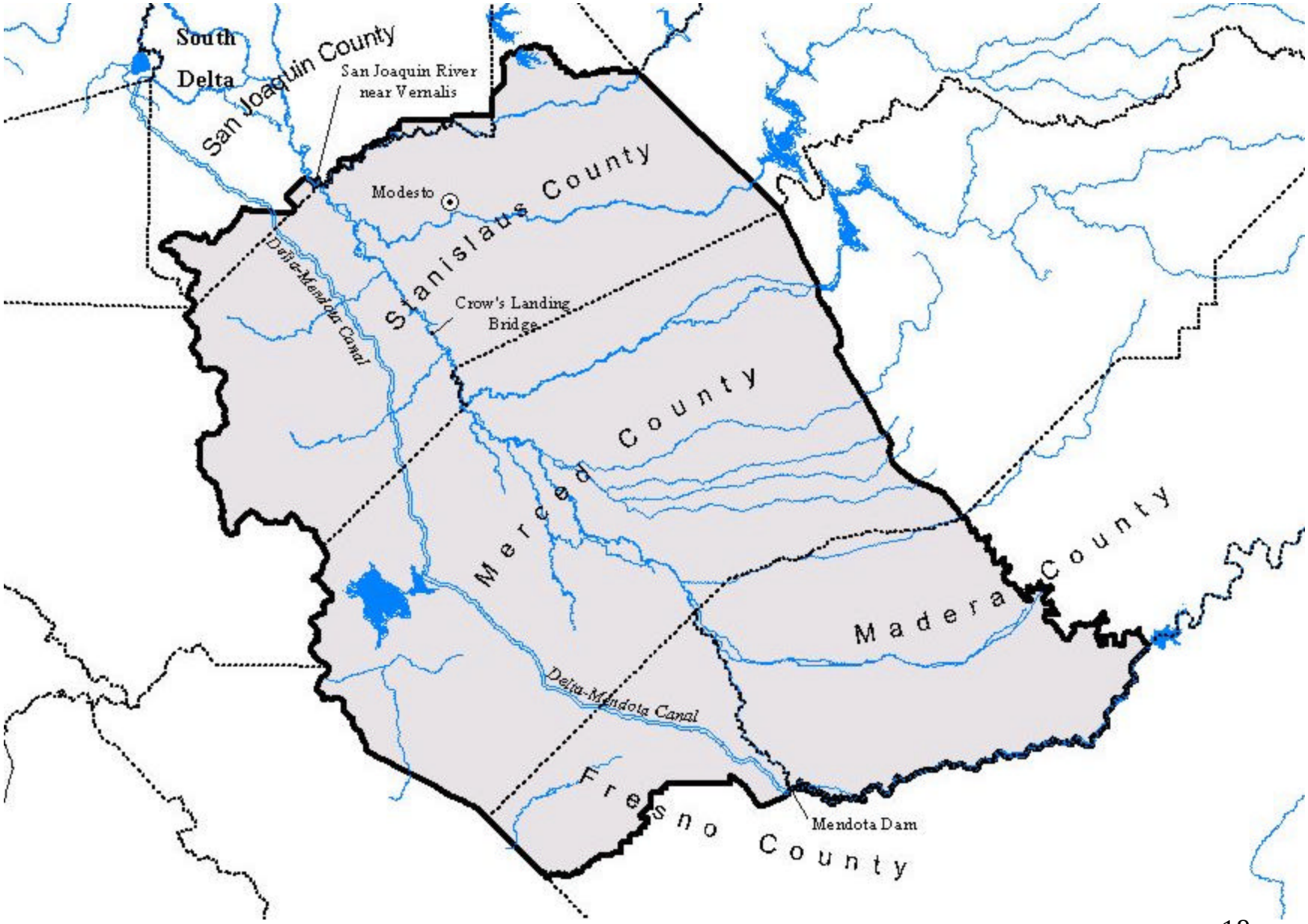
Problem Statement

- Background and history
- Applicable standards
- Beneficial uses
- Magnitude of the impairment
- Reasons for listing


Region 5
San Joaquin River Basin

Project Area for OP Pesticides TMDL




South
Delta
San Joaquin County
San Joaquin River
near Vernalis
Modesto
Stanislaus County
Delta-Mendota Canal
Crow's Landing
Bridge
Merced County
Madera County
Delta-Mendota Canal
Fresno County
Mendota Dam

Problem Statement

Basin Plan beneficial uses and water quality objectives

- Lower San Joaquin River beneficial uses include municipal and domestic water supply, agricultural supply, recreation, freshwater habitat, spawning and migration
- No numeric water quality objective for diazinon and chlorpyrifos
- Applicable narrative water quality objectives for pesticides and toxicity

Extent of Impairment

San Joaquin River near Vernalis

Diazinon	1997	1998	1999	2000	2001
# of Days CDFG Acute Criteria Exceeded	**0**	**4**	**2**	**2**	**6**
# of Days CDFG Chronic Criteria Exceeded	**3**	**7**	**3**	**8**	**6**
Number of Sampling Days	**34**	**42**	**42**	**60**	**64**
Maximum Concentration (ìg/L)	**0.07**	**0.1**	**0.15**	**0.1**	**0.235**

Extent of Impairment

San Joaquin River near Vernalis

Chlorpyrifos	1993	1994	1995	2000	Total (91-2001)
# of Days CDFG Acute Criteria Exceeded	**8**	**2**	**1**	**2**	**12**
# of Days CDFG Chronic Criteria Exceeded	**14**	**7**	**2**	**8**	**29**
Number of Sampling Days	**38**	**18**	**9**	**60**	**194**
Maximum Concentration (ìg/L)	**0.54**	**0.17**	**0.07**	**0.1**	**1.36**

Numeric Targets

Numeric Targets

- The numeric targets identify the instream goals or targets for the TMDL
- Regional Board will establish water quality objectives for diazinon and chlorpyrifos in the lower San Joaquin River
- The numeric targets will be proposed as water quality objectives in the Basin Plan Amendment process

Numeric Targets

- Regional Board staff produced a draft numeric target report in June 2001
- Comments focused on both technical issues and legal/procedural issues related to establishing water quality objectives
- Comments will be addressed as part of Basin Plan Amendment process
- Draft Target Report available on web:
  - http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/sjrop.html

Range of Numeric Targets

METHOD	CHLORPYRIFOS (ìg/L)		DIAZINON (ìg/L)	
	Acute	Chronic	Acute	Chronic
U.S. EPA Method as Used by U.S. EPA	0.08	0.041	0.09	NA
U.S. EPA Method as Used by DFG	0.02	0.014	0.08	0.05
Probabilistic Ecological Risk Assessment (PERA)	NA	0.148 [b (2)(3)]	1.117 [a (1)]	3.71 [b (1)]
Mesocosm/Microcosm	NA/NA	NA/NA	8.4/NA	NA/9.1
Please see next slide for footnotes.				

Range of Numeric Targets
Footnotes

a = 5th percentile

b = 10th percentile

(1) Novartis Crop Protection. An ecological risk assessment of diazinon in the Sacramento and San Joaquin river systems.

(2) Dow AgroSciences. A monitoring study to characterize chlorpyrifos concentration patterns and ecological risk in an agricultural dominated tributary of the San Joaquin River, 1998.

(3) Dow AgroSciences. Ecological risk of chlorpyrifos in North America aquatic environments, 1999.

Numeric Targets

- Analysis of water quality objectives will include consideration of:
  - Beneficial uses
  - Environmental characteristics of the watershed
  - Conditions that could be reasonably achieved
  - Economic considerations
  - Need to develop housing
  - Need to develop and use recycled water

Numeric Targets

- As recommended by Regional Board staff in the draft numeric target report, the proposed numeric targets for diazinon and chlorpyrifos are the Department of Fish & Game criteria
- Neither criteria to be exceeded more frequently than once every three years

Recommended Numeric Targets

Criterion Type	**Diazinon** (ìg/L)	**Chlorpyrifos** (ìg/L)	**Criterion Reoccurrence Period**
Acute	0.08	0.025	1-hour average; not to be exceeded more than once every three years
Chronic	0.05	0.014	4-day average; not to be exceeded more than once every three years

Basis: CDFG Freshwater Aquatic Life Criteria

Source Analysis

Emilie Reyes & Shakoora Azimi

Source Analysis Study

- To identify and characterize sources of diazinon and chlorpyrifos so we know where reductions must occur

Overview

- Summary of data types used for analysis
- Description of sub-areas
- Pesticide use
- Pesticide load

(Source Analysis Technical Report, Leva *et al*., draft 2002)

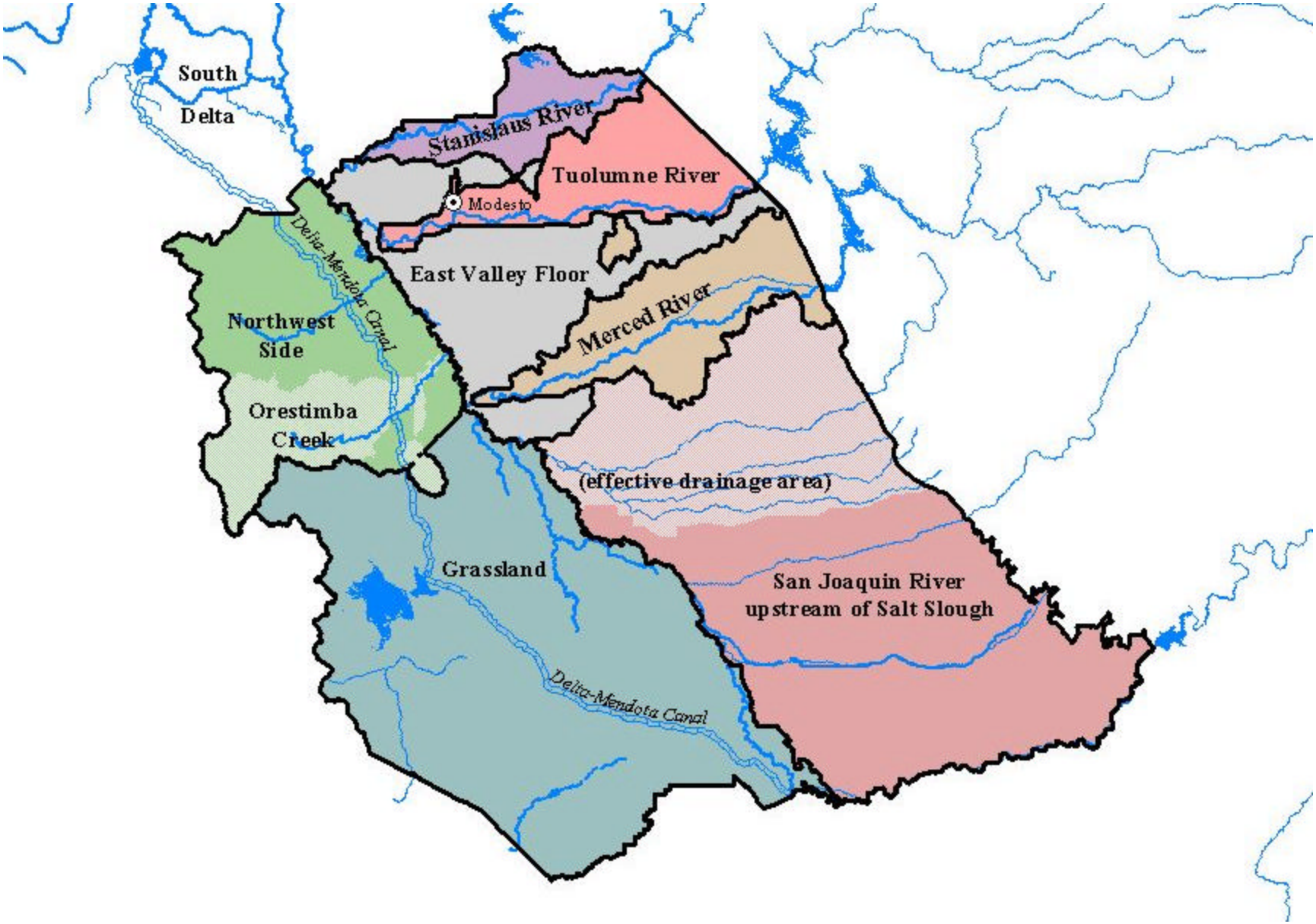
Data Types Used for Analysis

- Pesticide Use Reports (1995-2000)
- Pesticide Water Column Data (1990-2001)
- Flow Data (1990-2001)
- Precipitation (1990-2001)
- Land Use Data (year varies by county)

Sub-areas

Seven Sub-areas Defined

- Lower San Joaquin River upstream of Salt Slough
  - Effective Drainage Area
- Merced River
- Tuolumne River
- Stanislaus River
- East Valley Floor
- Grassland
- Northwest Side
  - Orestimba Creek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Stanislaus River
Tuolumne River
Modesto
East Valley Floor
Merced River
Delta-Mendota Canal
Northwest
Side
Orestimba
Creek
(effective drainage area)
Grassland
San Joaquin River
upstream of Salt Slough
Delta-Mendota Canal

LSJR upstream of Salt Slough

- 1,476 square miles
- Includes the portions of the Bear Creek, Chowchilla River and Fresno River watersheds
- Sampling point is LSJR at Lander Avenue
- *Effective drainage area: 523 square mile subset*

Merced River

- 294 square miles
- Merced River watershed downstream of the Merced-Mariposa county line
- Includes the area above Sand and Mustang Creek watersheds from which irrigation water is diverted to Highline Canal
- Sampling point is Merced River at River Road

Tuolumne River

- 253 square miles
- Tuolumne River watershed downstream of the Stanislaus-Tuolumne county line
- Sampling point is Tuolumne River at Shiloh Bridge

Stanislaus River

- 152 square miles
- Stanislaus River watershed downstream of the Stanislaus-Calaveras county line
- Sampling point is Stanislaus River at Caswell State Park

East Valley Floor

- 476 square miles
- Largely comprised of the land in between the major east-side drainages of the Tuolumne, Stanislaus, and Merced Rivers.
- Numerous drainage canals, including Harding Drain, and natural drainages

Northwest Side

- 603 square miles in size
- Includes Orestimba, Del Puerto, and Hospital/Ingram Creeks
- *Orestimba Creek : 204 square miles during the storm season and 11 square miles during the irrigation season; sampling point at Orestimba Creek at River Rd.*

Grassland

- 1,360 square miles
- On the west side of the LSJR
- Includes the Mud Slough, Salt Slough, and Los Banos Creek watersheds

Potential Sources of Chlorpyrifos and Diazinon

- Agricultural
  - Winter Dormant Spray Storm Runoff
  - Summer Irrigation Tailwater Runoff
- Urban
  - Urban Storm Runoff
- Atmospheric Deposition

Source Analysis

- Part I
  - Diazinon and Chlorpyrifos Use Pattern
- Part II
  - Diazinon and Chlorpyrifos Load

Source Analysis
Part I

Diazinon and Chlorpyrifos Use Patterns

Diazinon and Chlorpyrifos Use Patterns

- PURPOSE: Determine temporal and spatial diazinon and chlorpyrifos application (use) patterns in the project area

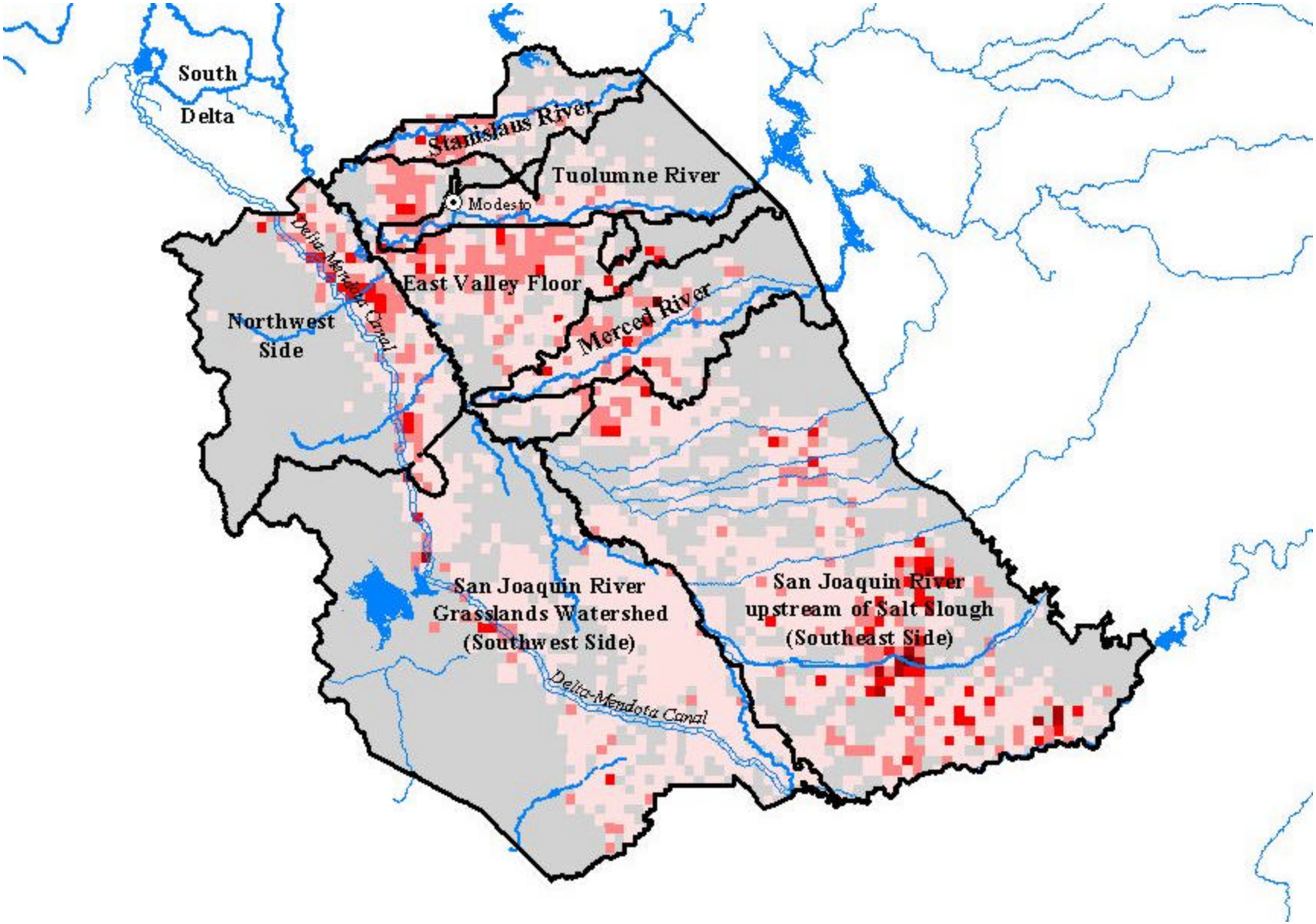
- METHOD: Analyze diazinon and chlorpyrifos use by commodity, time, and location of applications

Pesticide Use Report (PUR)

- PUR database maintained by Dept. of Pesticide Regulation
- Ongoing program, started in 1990
- Includes:
  - Agricultural pesticide applications (by date, section)
  - Commercial structural pest control and commercial residential/landscaping applications (by month, county)
- Does not include:
  - Non-commercial application (e.g. residential indoor and outdoor use)

Pesticide Use

- Agricultural
  - Dormant
  - Irrigation
- Urban
  - Structural Pest Control
  - Landscape Maintenance
  - Private Citizen (unreported)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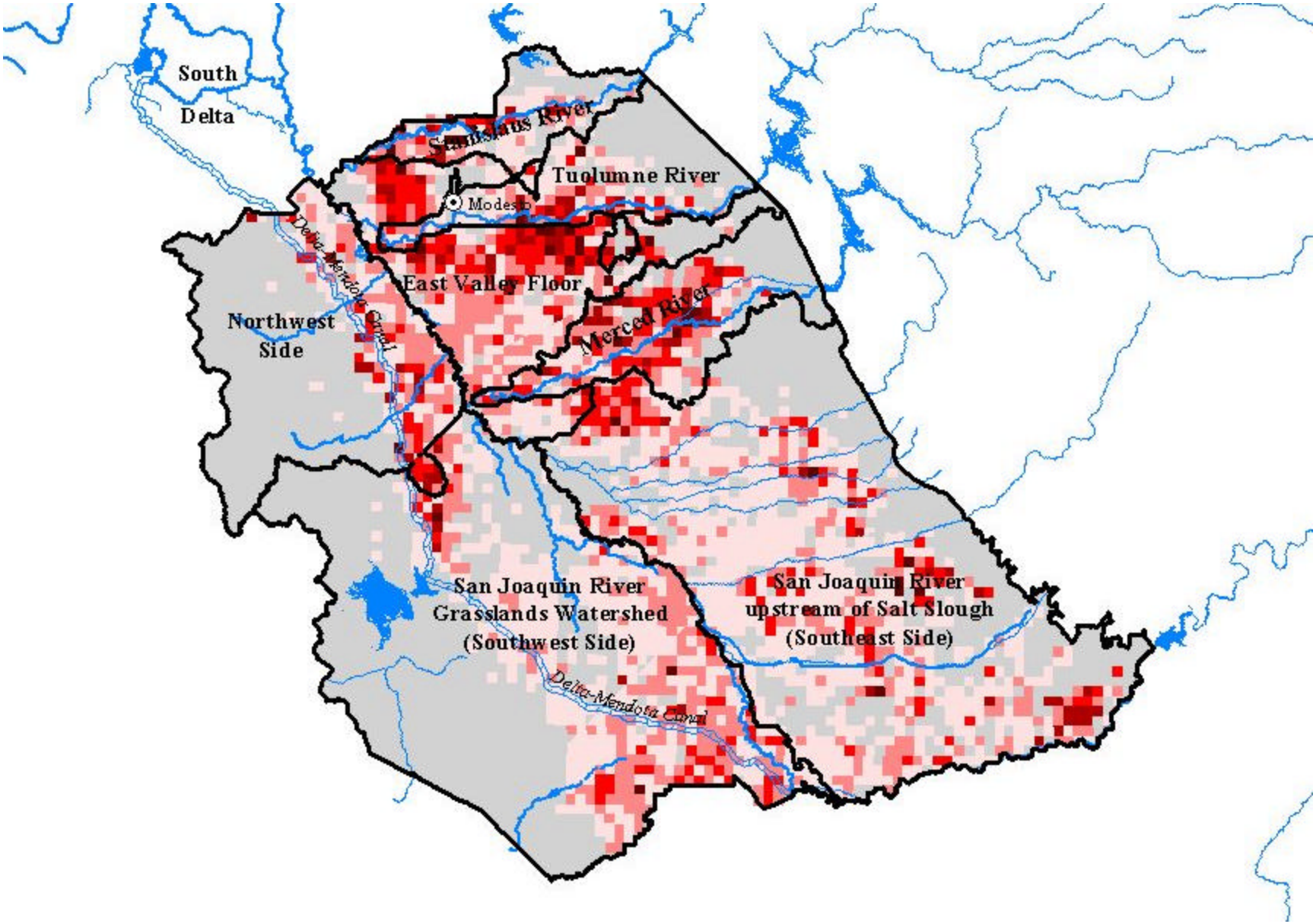
Grasslands Watershed
(Southwest Side)
San Joaquin River
upstream of Salt Slough
(Southeast Side)
Delta-Mendota Canal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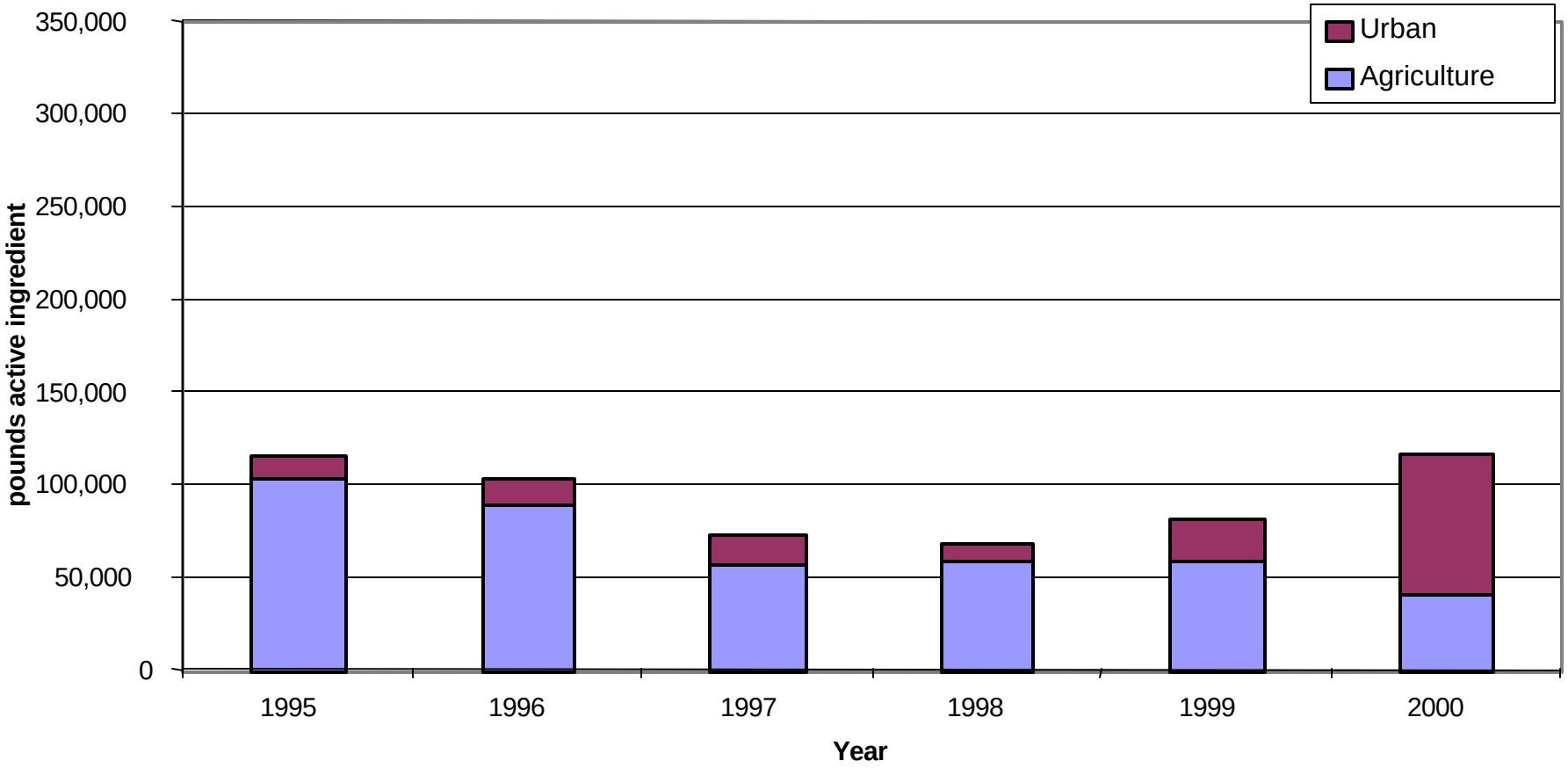
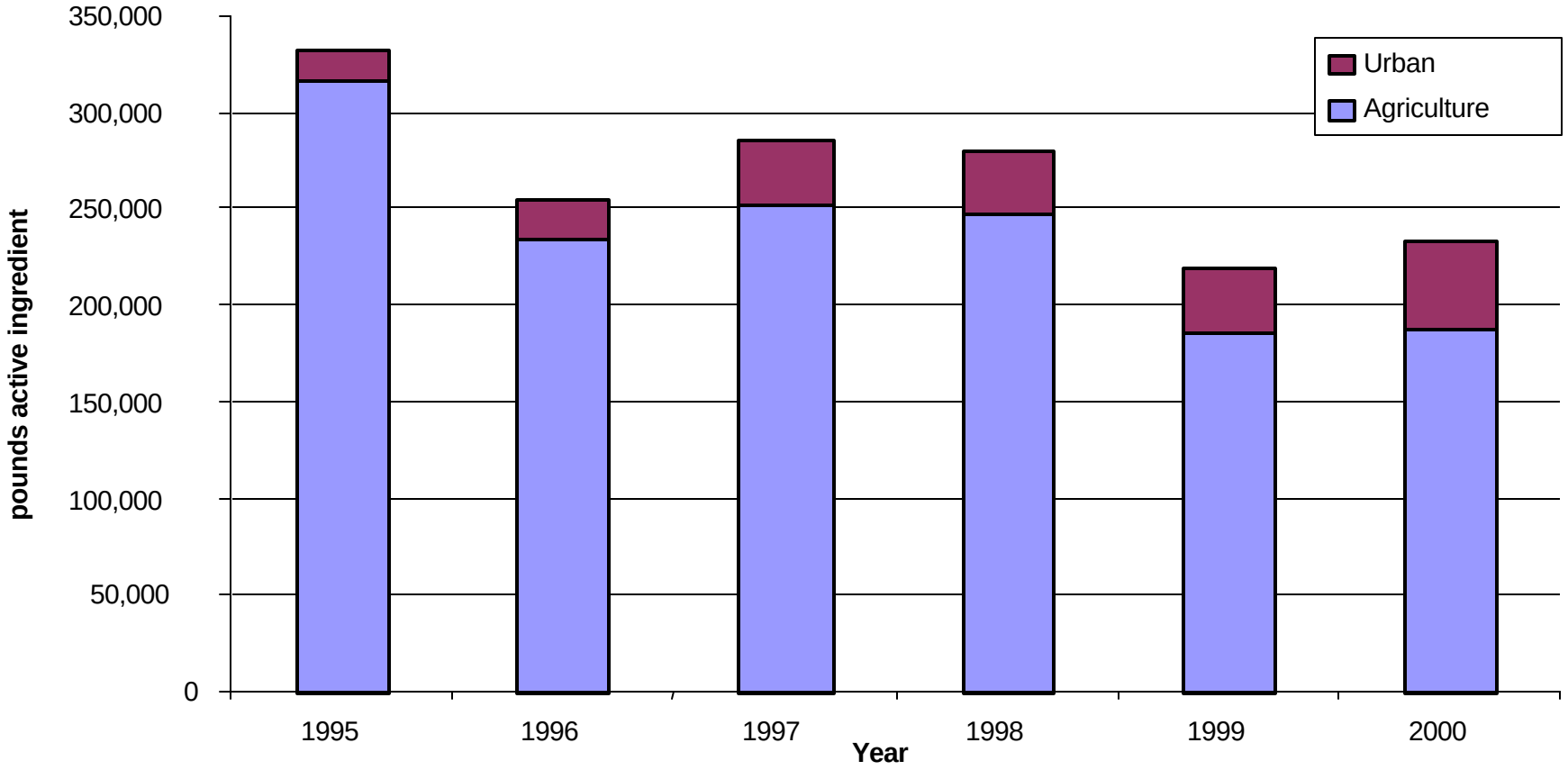
Delta-Mendota Canal

Diazinon Use Patterns
Annual

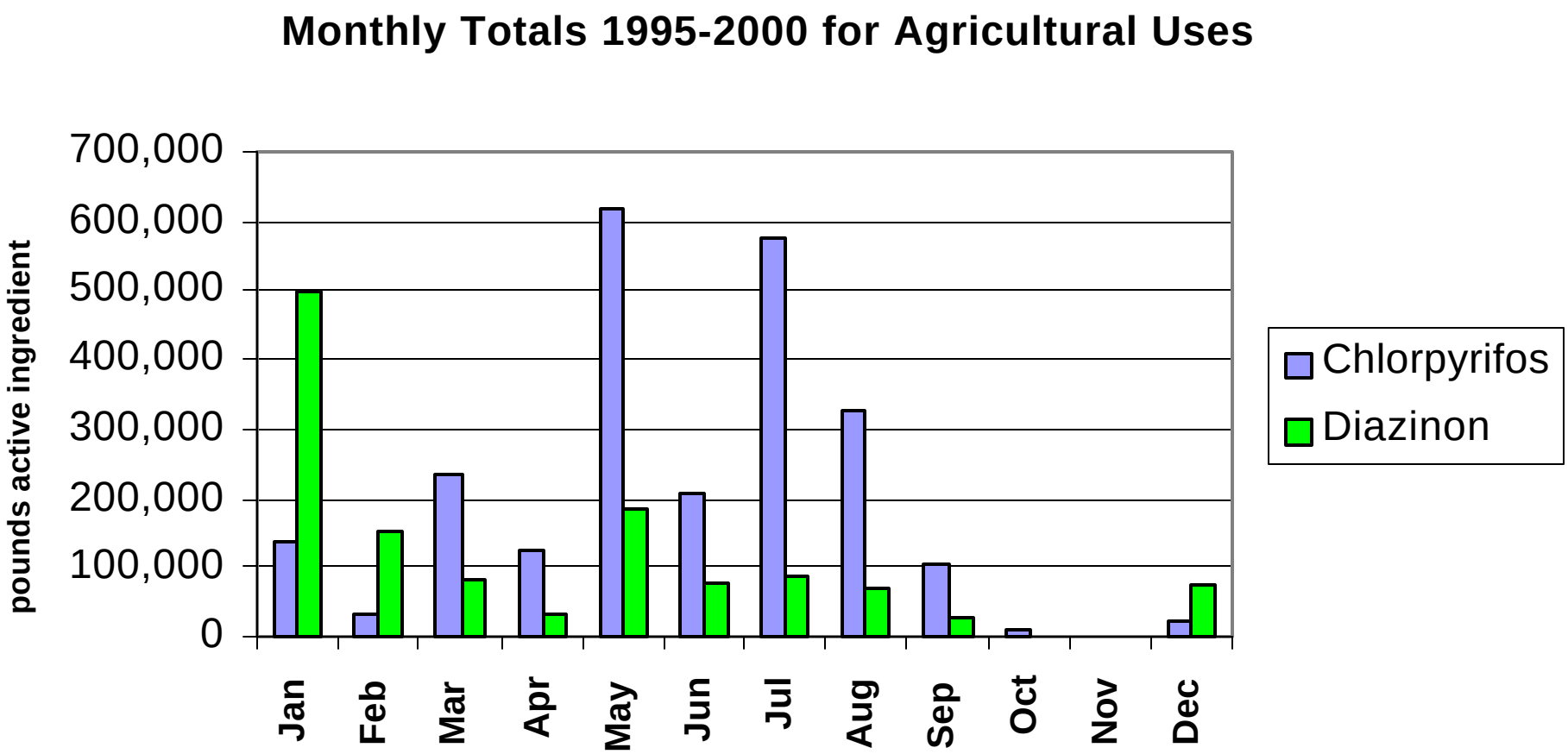


Chlorpyrifos Use Patterns

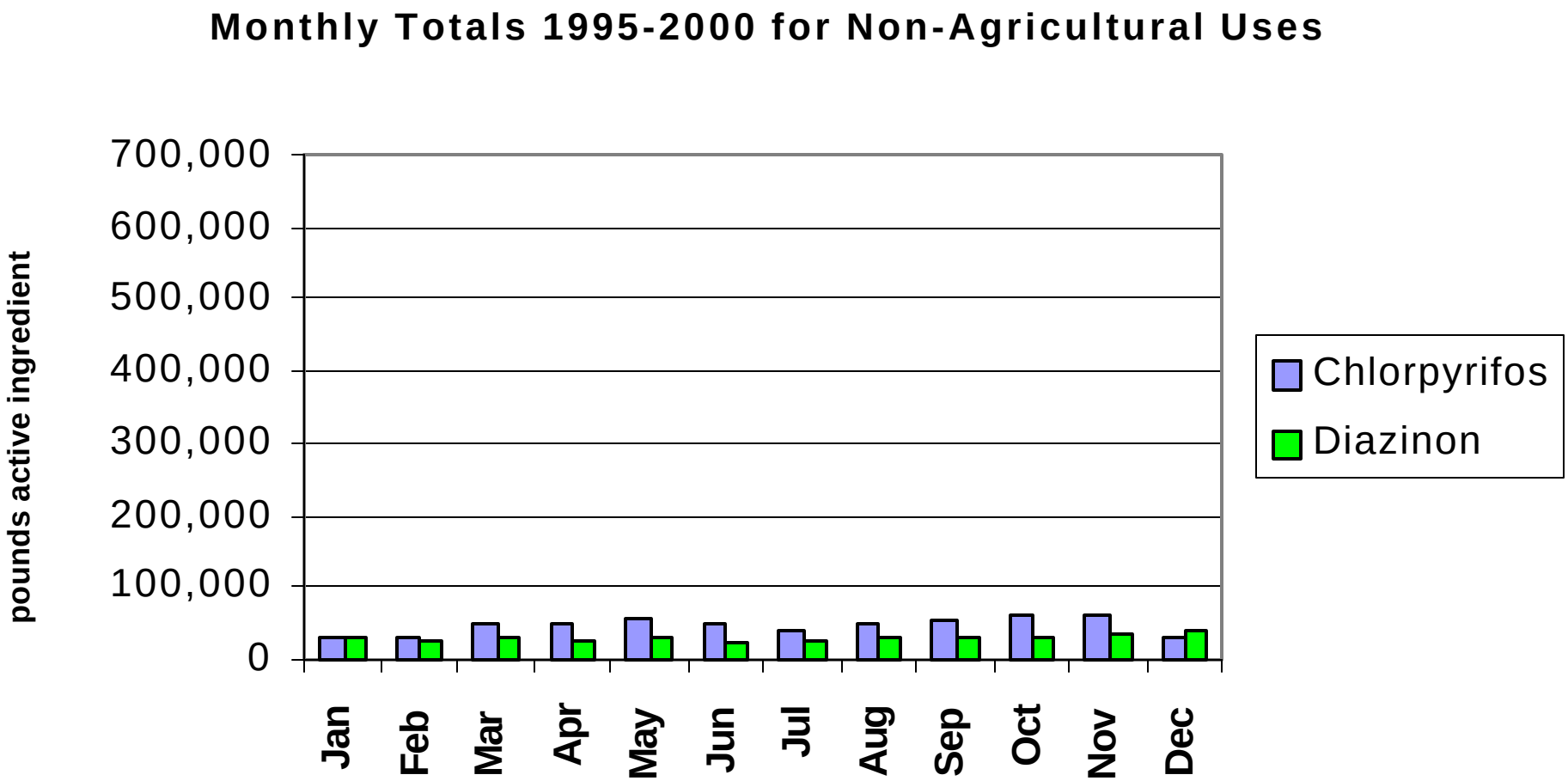
Annual



Monthly Totals for Agricultural Uses



Monthly Totals for Non-Agricultural Uses



Urban Use

Chlorpyrifos and Diazinon

- **Reported Use**:

Structural pest control	> 90%
Landscape maintenance	1-3%
Other non-residential uses	0-3%

- **Unreported Use**:

  Estimate of residential use

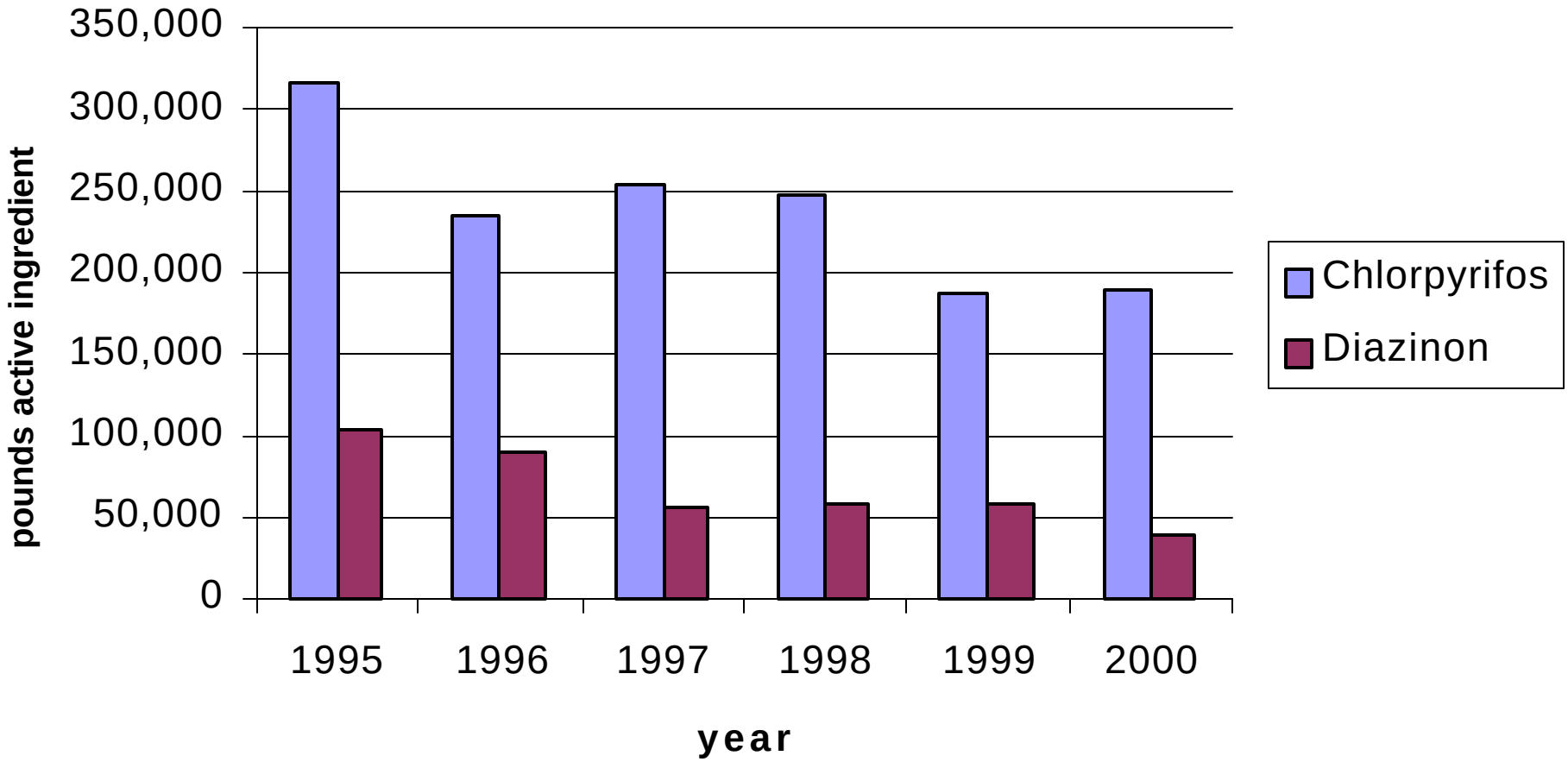
Urban Use

Stanislaus	Merced	Madera	Fresno	San Joaquin
65%	25%	7%	2%	1%
63%	29%	5%	2%	1%

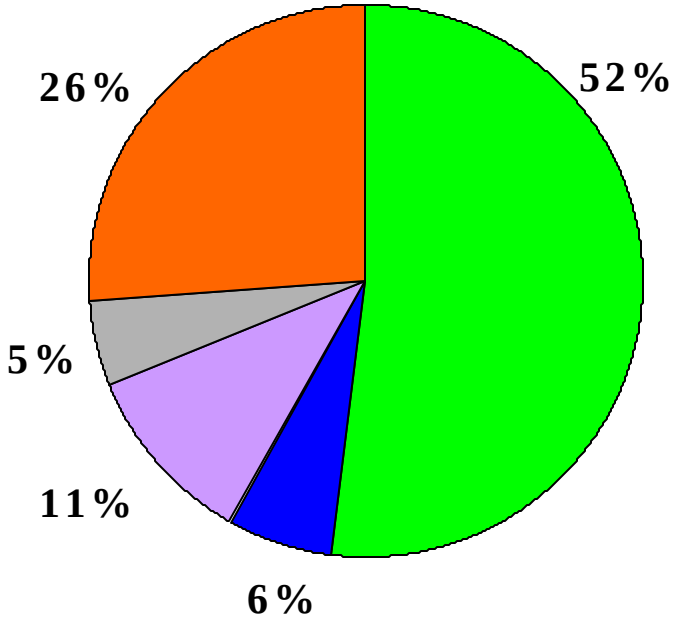
Diazinon

Chlorpyrifos

Agricultural Use Patterns

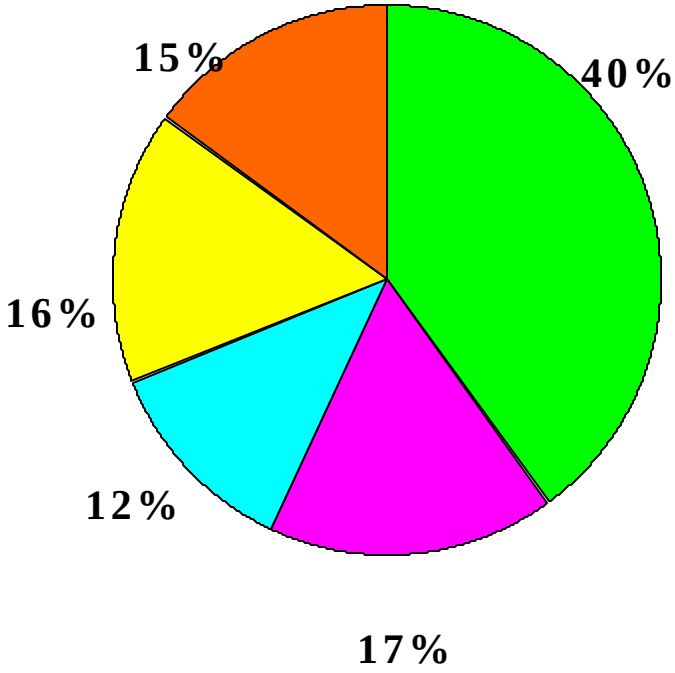


Pesticide Use on Different Crops
Annual Average 1995-2000



Diazinon

Almond
Apricot
Peach
Prune
Other



Chlorpyrifos

Almond
Alfalfa
Walnut
Cotton
Other

Agricultural Use Patterns

For purposes of extracting data, seasons were defined as:

- Dormant: December through March (overlap in March possible)
- Irrigation Season: April through September

Diazinon Use Patterns Summary

- Major reported dormant spray season crop uses: almonds, peaches, apricot
  - General decrease in reported diazinon use during dormant spray season
- Major reported irrigation season crop uses: almond, cantaloupe, melons, apricot, walnut
  - Almost no use in 2000 on almond during irrigation season

Chlorpyrifos Use Patterns Summary

- Major reported irrigation season crop uses: almond, walnut, cotton, alfalfa
- Major reported dormant spray season crop uses: alfalfa, almonds, apple

Seasonal Use By Sub-area

SUBAREA	Percent Average Use			
	Diazinon		Chlorpyrifos	
	Dormant	In Season	Dormant	In Season
SJR u/s Salt Slough	45%	28%	33%	28%
Merced R	6%	8%	10%	14%
Tuolumne R	4%	2%	2%	6%
Stanislaus R	4%	1%	1%	5%
East Valley Floor	20%	13%	24%	20%
Grassland	7%	10%	15%	21%
Northwest Side	12%	7%	12%	6%

Treated Acres by Sub-area

- PUR was also used to determine crop acreages treated with diazinon or chlorpyrifos in each subarea; for example:
  - **For dormant season diazinon crop uses:**
    - Almond: SJR upstream Salt Slough (36%), East Valley Floor (23%)
    - Apricot: Northwest side (60%), Tuolumne R (33%)
  - **For irrigation season chlorpyrifos uses:**
    - Alfalfa: SJR upstream Salt Slough (48%), Merced R (30%)
    - Corn: Merced R (47%), SJR upstream Salt Slough (14%), Grassland (14%)

Source Analysis
Part II

Diazinon and Chlorpyrifos Load in Surface Water

Source Analysis

Information Used

- Diazinon and Chlorpyrifos Use Data - CDPR Pesticide Use Report database
- Water Quality Data - water quality monitoring from 1990 through 2001 by USGS, Regional Board, CDPR
- River Flow Data - USGS and DWR gaging stations, discharge measurements made during water quality studies

Pesticide Data Sources

- Studies by DPR, USGS, and Regional Board
- Field studies designed to characterize pesticide occurrence and source
- Since 1990, over 10 major studies in SJR Basin
- Studies collected over 3,000 samples
- Extensive long-term sampling at Vernalis (characterizes basin mass emissions)

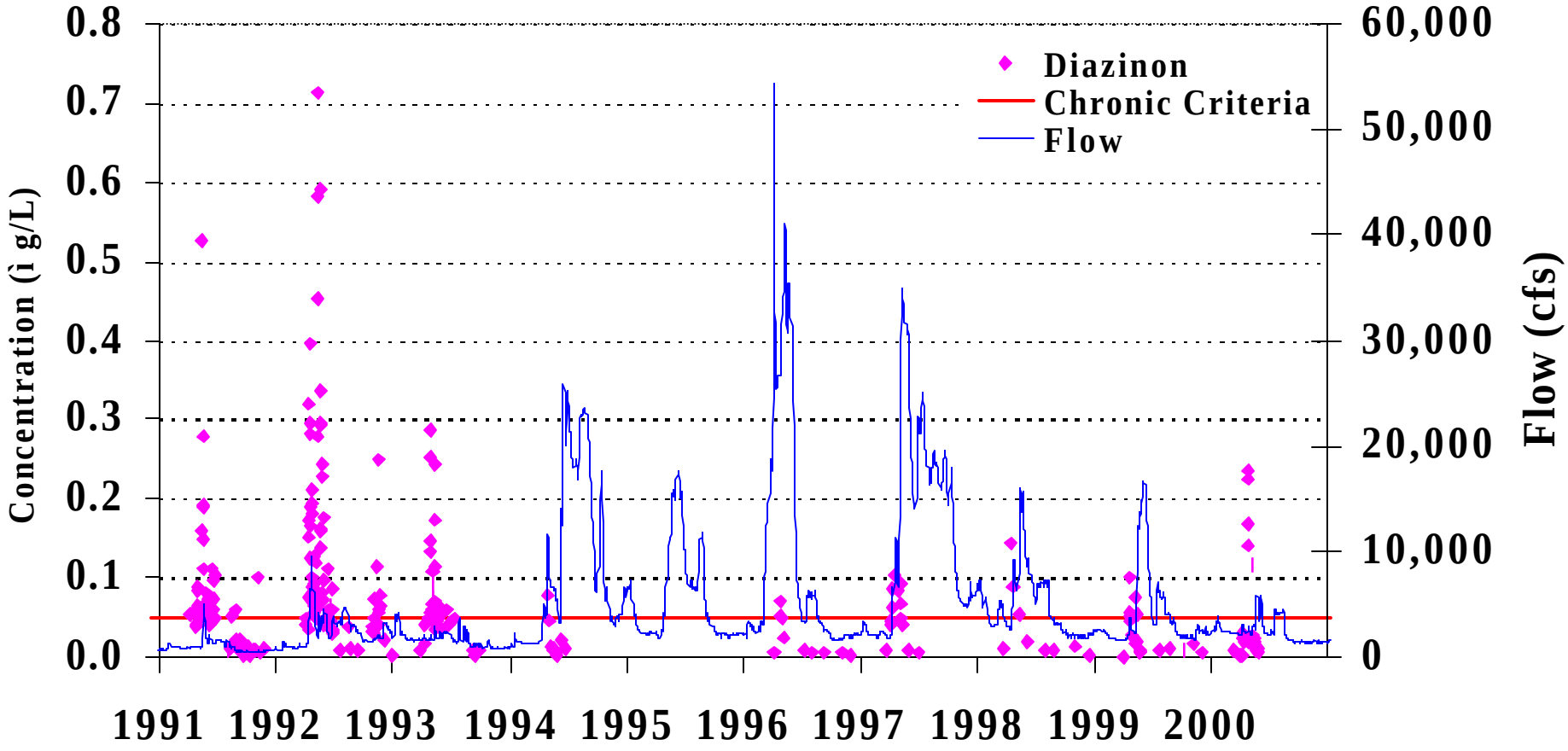
Source Analysis Methodology

- Diazinon and Chlorpyrifos loads calculated when possible

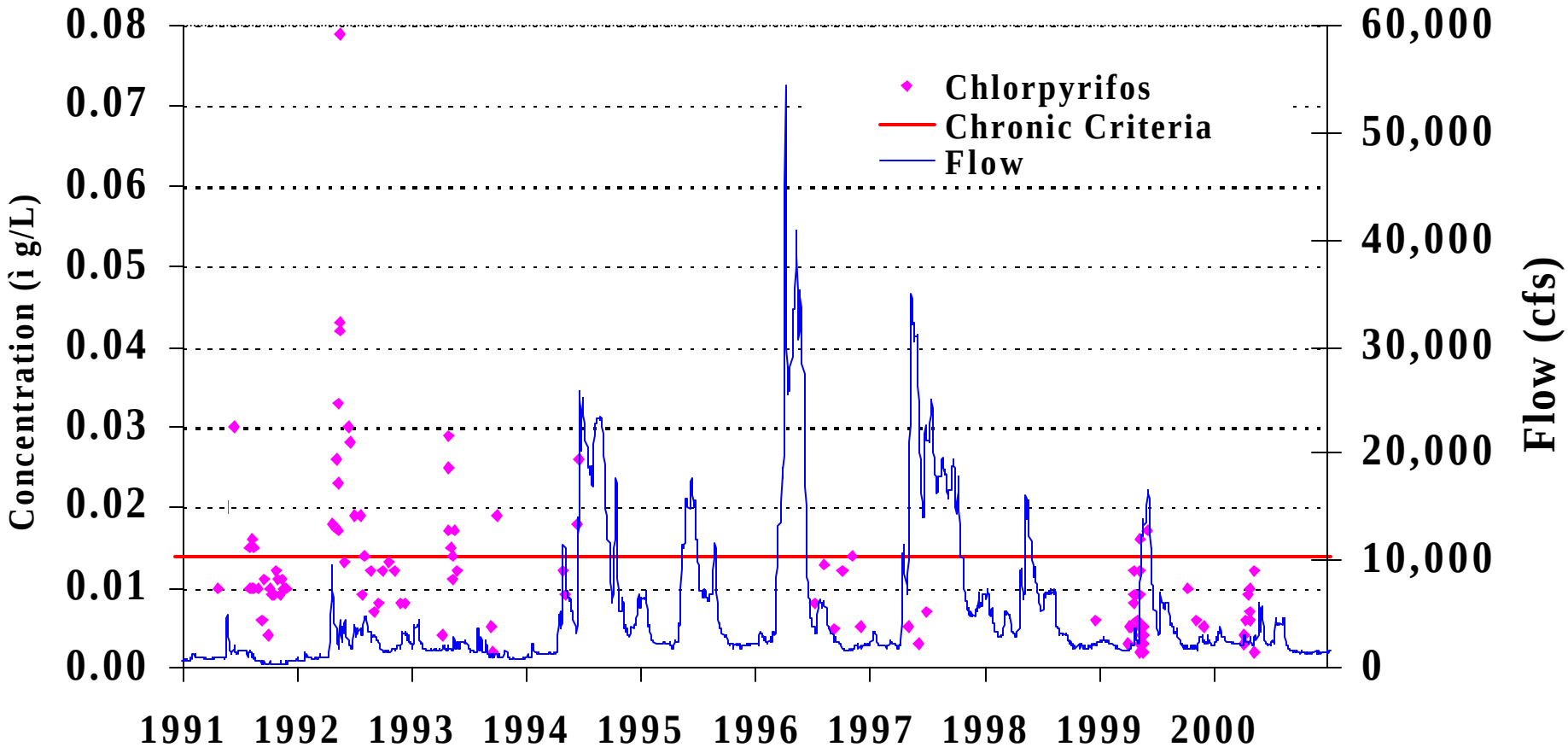
  Load = Concentration * Flow

- Loading from different sub-areas

Diazinon Concentration and Daily Flow
SJR near Vernalis



Chlorpyrifos Concentration and Daily Flow
SJR near Vernalis



Pesticide Use

- Agricultural
  - Dormant
  - Irrigation
- Urban
  - Structural Pest Control
  - Landscape Maintenance
  - Private Citizen (unreported)

Load from Various Source Categories

- Dormant Spray Season Load

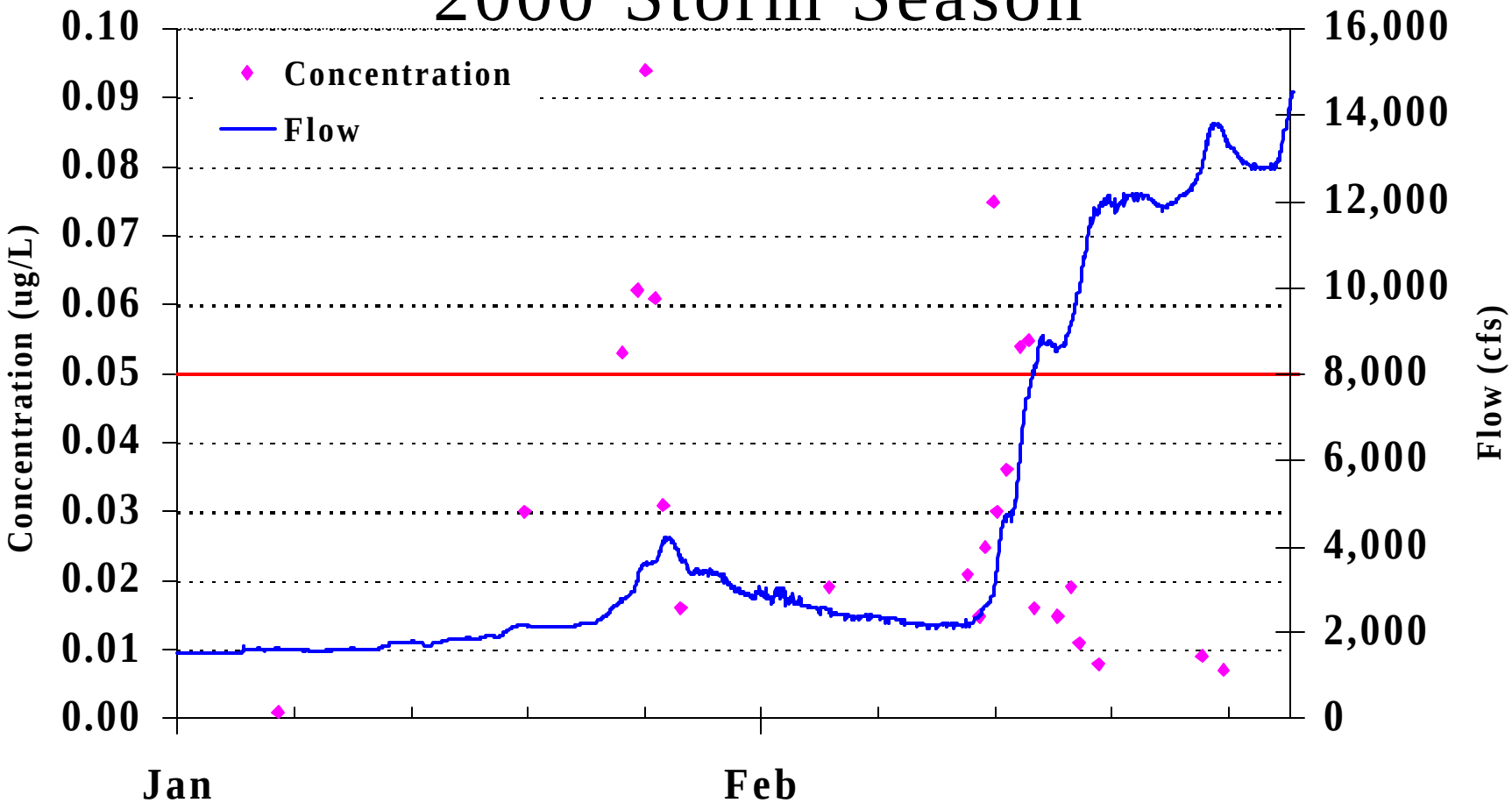
  Load from agricultural and urban sources

- Irrigation Season Load

  Load from agricultural sources

- Atmospheric Loads

Diazinon – SJR near Vernalis
Instantaneous Flow and Concentration
2000 Storm Season

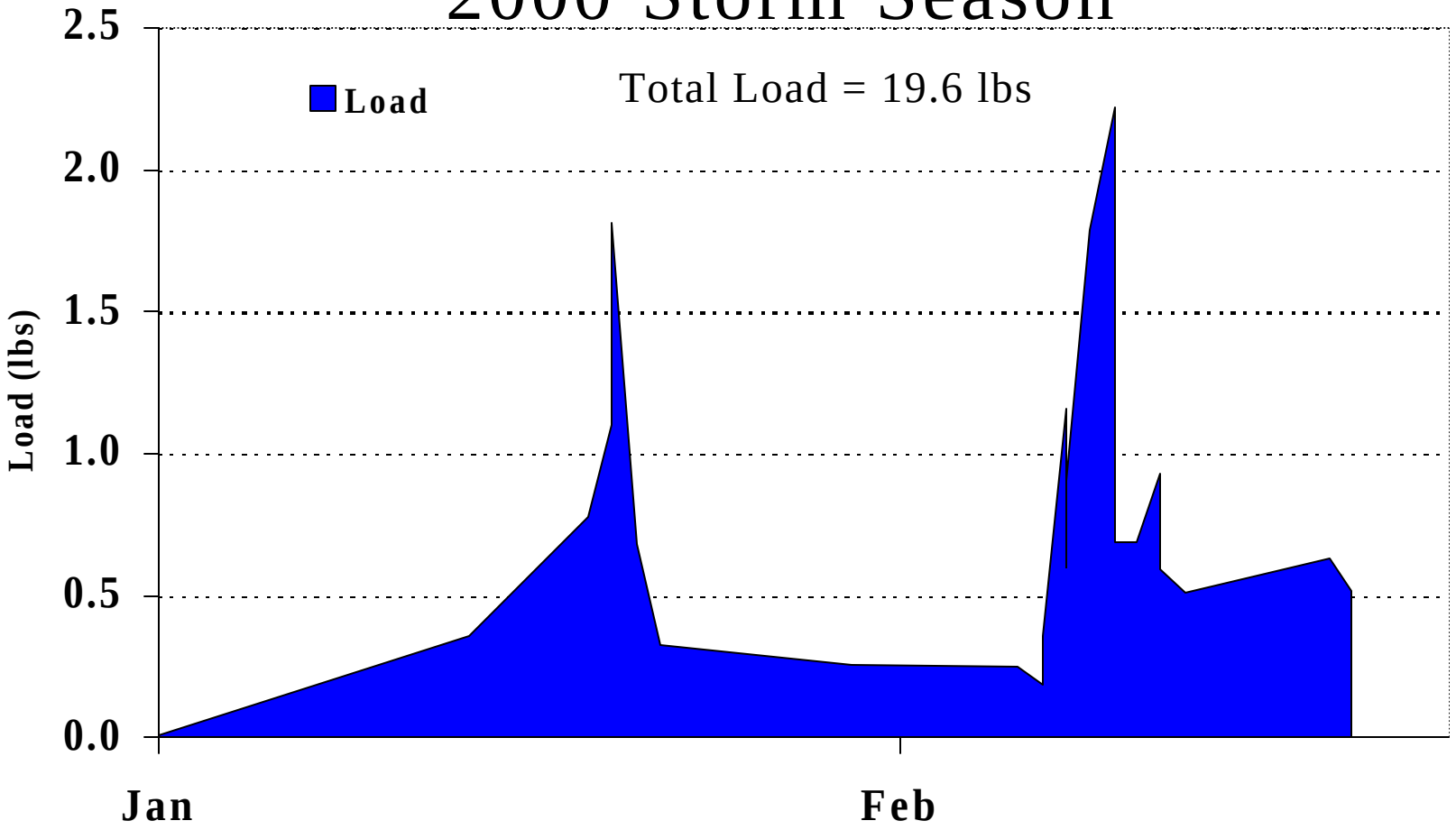


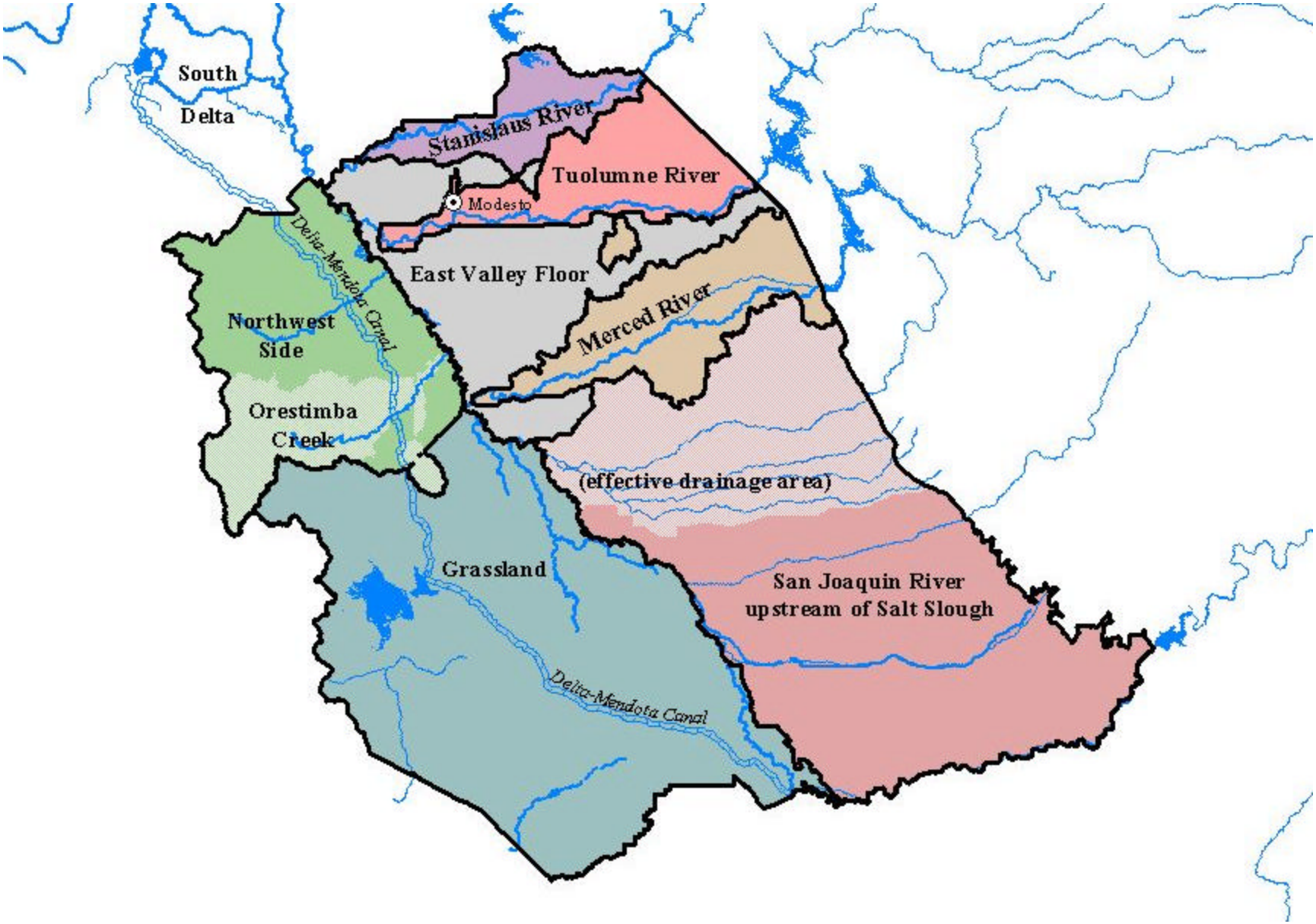
Calculating Storm Load

- Collect concentration and flow data during storm event
- Compute instantaneous loads

  = concentration x flow x conversion factor
- Graph instantaneous loads
- Estimate total storm load as area beneath curve

Diazinon – SJR near Vernalis
Instantaneous Load
2000 Storm Season

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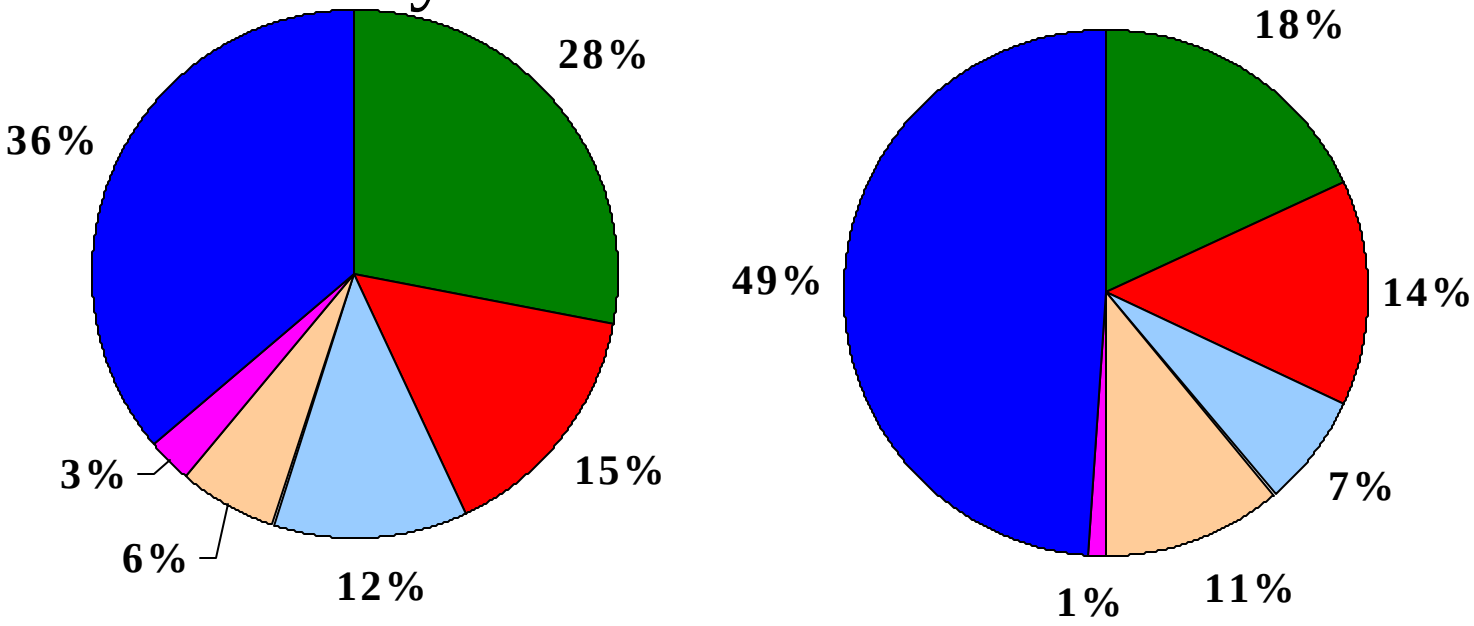
Comparison of Single Storm Loads From Major SJR Tributaries Preliminary Results 9-14 Feb 2000

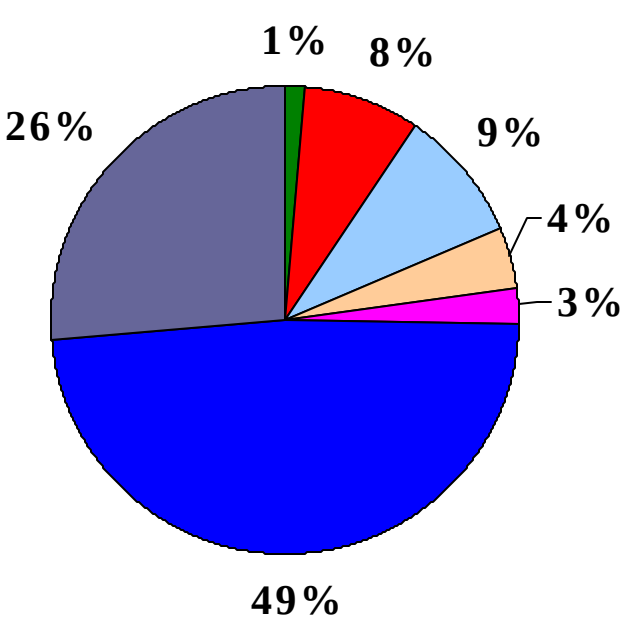


2000 Single Storm Loads at Vernalis: Diazinon – 4.9 lbs Chlorpyrifos – 1.5 lbs

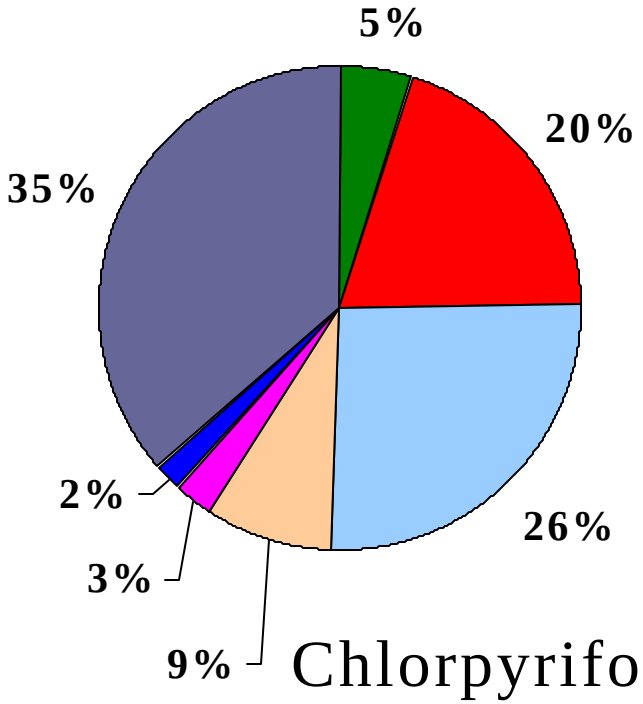
Irrigation Season Load

- Similar methods are used to estimate loading during irrigation season
- Available data is more sparse
- 2001 synoptic study suggests that diazinon & chlorpyrifos are widely distributed in the San Joaquin River Basin from irrigation return flow

Comparison of Irrigation Season Loads From Major SJR Tributaries Preliminary Results 2001



Diazinon



Chlorpyrifos

SJR upstream of Salt Slough | Tuolumne River | Stanislaus River
Merced River | Orestimba Creek | Other Sources
Mud & Salt Sloughs

2001 150-day Irrigation Season load Diazinon: 16 lbs. Chlorpyrifos: 11 lbs.

Atmospheric Load

- USGS has monitored storm runoff from the McHenry storm drain in Modesto while simultaneously collecting composite rain samples at four sites in the Modesto metropolitan area during a January 2001 storm event

Atmospheric Load

- Rain sample data was collected to determine the contribution of atmospheric deposition

Atmospheric Load

- The USGS atmospheric deposition study in the SJR Basin is continuing
- Preliminary 2002 rainfall data from agricultural and urban sites suggest the concentration of diazinon and chlorpyrifos detected in rainfall is correlated to agricultural spraying

Atmospheric Load

- Increases in diazinon concentrations detected in rainfall collected from agricultural sites coincide with the dormant spray season, and increases in chlorpyrifos concentrations coincide with dormant spray as well as alfalfa spraying in early March

Dormant Spray Season Summary

- Concentrations of diazinon and chlorpyrifos frequently above criteria
- Occurrence of pesticides and frequency of exceeding WQOs are persistent over time
- Persistent spatial distribution:

  each sub-area contributes to load

Dormant Spray Season Summary (continued)

- Data suggests that agriculture is primary source:
  - Association of agricultural application to observed loads
  - Sub-area sources of loads
  - Consistent with conclusions reached by USGS studies

Irrigation Season Summary

- Available data is more sparse
  - Detectable concentration of diazinon and chlorpyrifos in 2001 Irrigation Monitoring
  - Most recent year still being compiled
  - Additional information will be obtained this summer
- Available data suggests that agriculture is the primary source
  - Chlorpyrifos and diazinon are widely distributed from irrigation return flow

Summary Atmospheric Load

- The trend in monitoring data collected from the urban site in downtown Modesto appears to be similar to that from agricultural sites
  - suggesting that the diazinon or chlorpyrifos detected in the rain in the urban site is more likely due to agricultural than urban application.

Lunch Break

Linkage Analysis

Matt McCarthy

Purpose

- Basis for determining SJR pesticide loading to meet numeric target
- Assimilative capacity calculated with numeric target and anticipated flow (design)
- Provides framework for load allocation calculations

Assumptions

- Pollutant properties
- Criteria specifications
- Flow Regimes
- Site Selection
- Seasonality
- Additivity

Assumptions

- Pollutant properties
- Criteria specifications
- Flow Regimes
- Site Selection
- Seasonality
- Additivity

Seasonality

- Two seasons of use
- Dormant
  - December through February
- Irrigation
  - March through November

Additivity

- Each pesticide load must be reduced to account for other pesticide

Method

- Hydrologically based modeling approach
- Determine full assimilative capacity of various reaches of SJR
- Requires estimate of expected minimum flow conditions (design flows)
- Adapted from USEPA methods
- Similar to Selenium TMDL method

Method

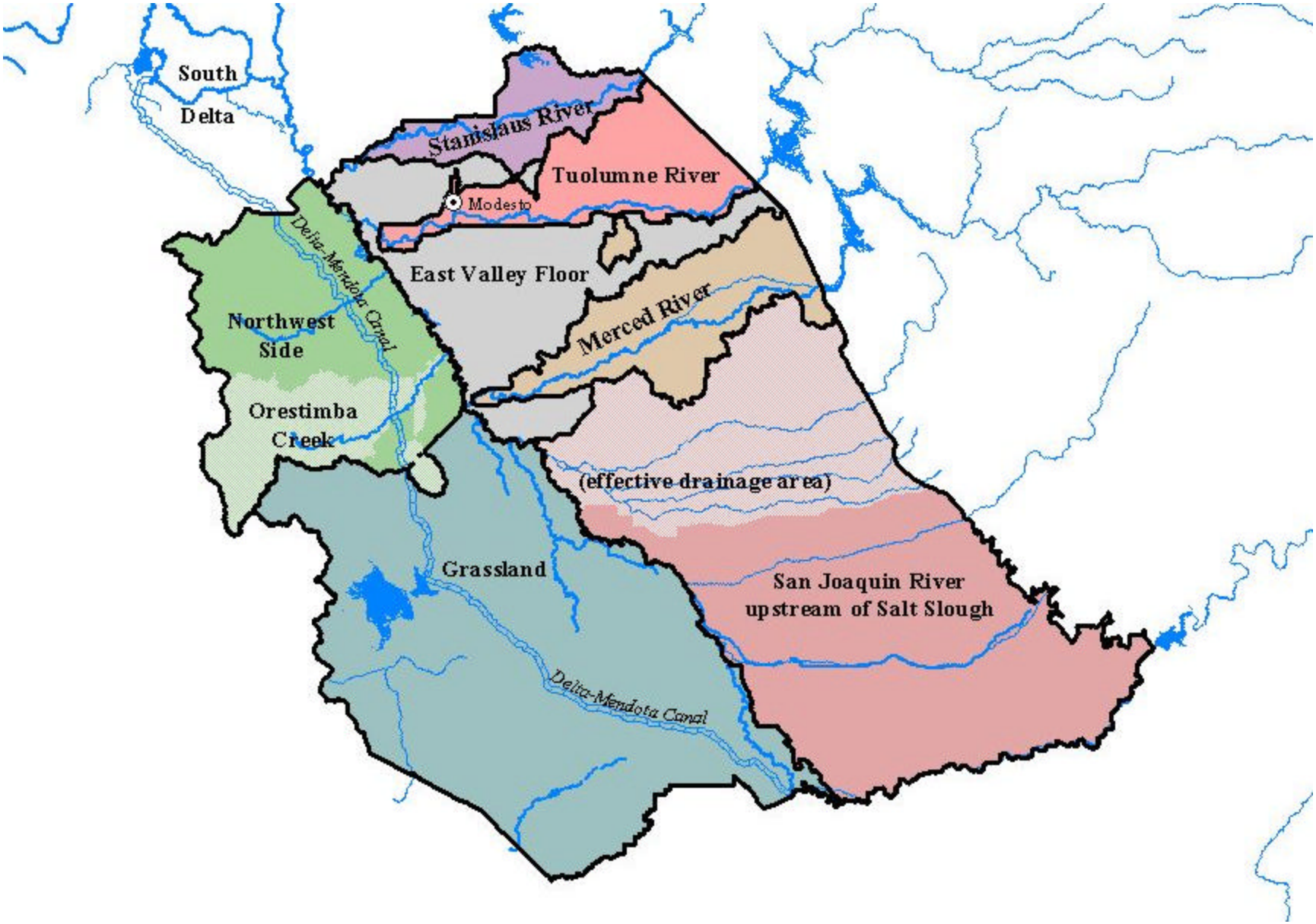
- Identify sites and seasons of interest
- Select rainfall event, flow averaging period
- Assemble/process flow and rainfall data
- Select data for periods of interest
- Select design flow (assimilative capacity)
- Calculate total allowable load

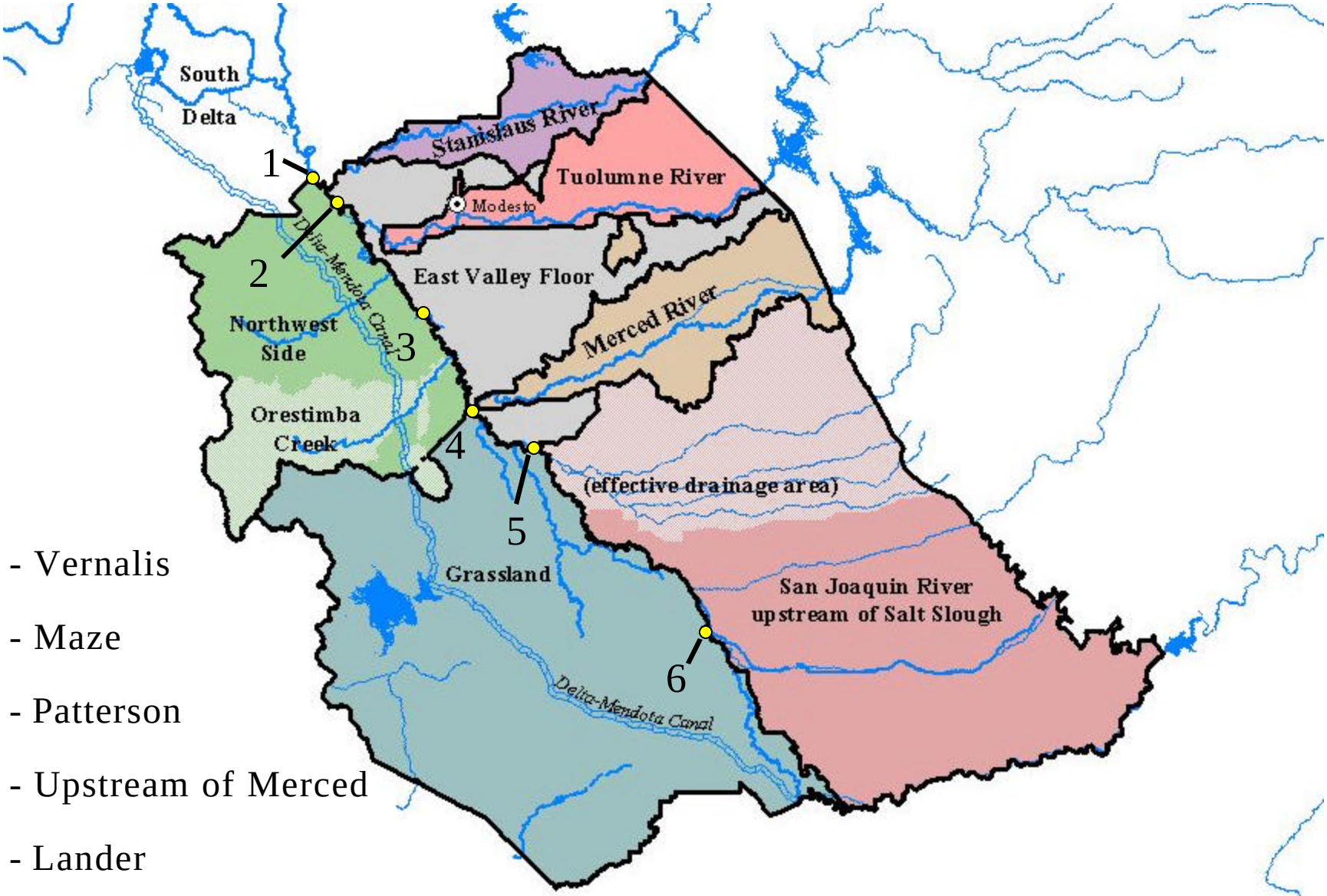
Sites and Seasons of Interest

- Lower SJR flow highly dependent on tributaries and managed hydrology
- Six reaches with different hydrologies
- Single site used to assess flows for each reach
- Seven subareas contribute flow

Select Sites and River Reaches

River Site	River Reach
Sack	Mendota Dam to Sack Dam
Lander	Sack Dam to Lander Avenue (Highway 165)
Upstream of Merced	Lander Avenue to Merced River Confluence
Patterson	Merced River Confluence to Tuolumne River Confluence
Maze	Tuolumne River Confluence to Stanislaus River Confluence
Vernalis	Stanislaus River Confluence to Vernalis


South
Delta
Stanislaus River
Tuolumne River
Modesto
East Valley Floor
Merced River
Delta-Mendota Canal
Northwest
Side
Orestimba
Creek
(effective drainage area)
Grassland
San Joaquin River
upstream of Salt Slough
Delta-Mendota Canal



1 - Vernalis

2 - Maze

3 - Patterson

4 - Upstream of Merced

5 - Lander

6 - Sack

Select Sites and Subareas

Subarea	Site					
	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
Upstream of Salt Slough	X	X	X	X	X	X
Grassland	X	X	X	X		
East Valley Floor	X	X	X			
Northwest	X	X	X			
Merced	X	X	X			
Tuolumne	X	X				
Stanislaus	X					

Rainfall Event and Averaging Period

- Numeric Target values used
- Acute Criteria
  - One-hour average period
  - Use daily average flow
- Chronic Criteria
  - Four-day average period
  - Use running four-day average flow
- Allowable rate of one excursion every three years

Assemble and Process Data

Flow

- 22-year period (1980-2001)
- Data from USGS and DWR, supplemented with CDEC
- Most representative of current level of development in SJR Basin
- Seven sites used

USGS: United States Geological Survey

DWR: Department of Water Resources

CDEC: California Data Exchange Center

Assemble and Process Data

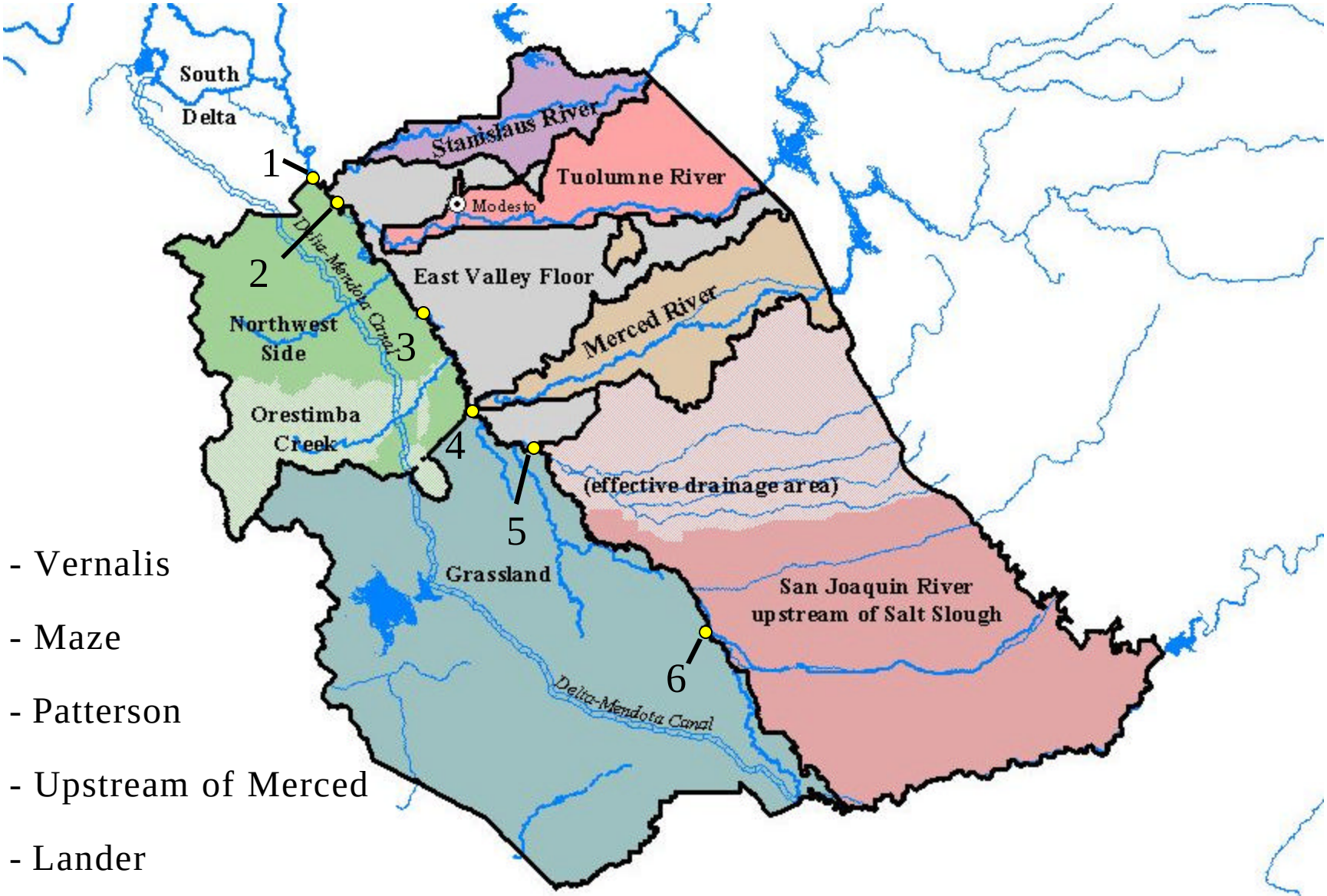
Flow

- SJR flows
- Full record available for:
  - Vernalis
  - Patterson
  - Lander
- Full record unavailable for:
  - Maze
  - Upstream of Merced
  - Sack Dam

Assemble and Process Data

Flow

- Calculated flow data to fill gaps:
  - Maze = Vernalis - Stanislaus
  - Upstream of Merced = Lander + Salt Slough + Mud Slough
  - Sack Dam = Mendota Dam



1 - Vernalis

2 - Maze

3 - Patterson

4 - Upstream of Merced

5 - Lander

6 - Sack

Available Flow Record

Site	USGS	DWR	CDEC
SJR near Vernalis	1980-2000	---	2001
Stanislaus near Ripon	1980-2000	---	2001
SJR at Patterson	---	1980-2001	---
Salt Slough at Lander	1985-2000	1980-1985	---
Mud Slough near Gustine	1985-2000	---	---
SJR at Lander	---	1980-2001	---
SJR at Mendota Dam	---	---	1993-2002

Assemble and Process Data

Precipitation

- Occurs primarily during winter months
- Data from UCIPM database
- Four groups of sites based on location
- Average rainfall calculated for each group
  - Precipitation weighted for each subarea

- UCIPM: University of California Integrated Pest Management

Select Data

Dormant Season

- Consider data for December through February
- Rainfall runoff events
  - 0.25” and 0.50” daily rainfall event triggers
  - Two to four day runoff collection periods
  - Peak concentrations occur during these events
- Results in six categories
  - Two rainfall triggers
  - Three runoff periods

Select and Process Data

Irrigation Season

- Consider data for March through November
- No rainfall runoff component
- All flow data considered

Select Design Flow

- Daily and four day average flow rank ordered from lowest to highest
- 1 in 3 year excursion rate
- 7 allowable excursions in 22 year record
- Design flow is 7^{th} lowest flow
- No more than 5 excursions during any 120 day period
- Lowest design flow selected

Design Flows

1 in 3 year Exceedance Rate

Season	Criteria	Category	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
		Rainfall (in) and Days	---------- cfs ----------					
Dormant	Acute	0.25&2d	946	741	321	82	1	63
		0.25&3d	924	741	321	82	1	62
		0.25&4d	910	737	321	80	1	62
		0.50&2d	1400	1019	493	166	3	94
		0.50&3d	1400	1019	493	166	3	65
		0.50&4d	1400	1019	493	156	3	64
	Chronic	0.25&2d	903	734	350	88	1	63
		0.25&3d	903	734	350	88	1	62
		0.25&4d	903	734	350	87	1	62
		0.50&2d	1655	1274	697	137	2	82
		0.50&3d	1605	1274	691	132	2	80
		0.50&4d	1590	1274	637	126	2	72
Irrigation	Acute		446	173	164	10	1	20
	Chronic		481	186	179	10	1	21

Design flows based upon 7th lowest flow in 22-year flow record (1 in 3 year excursion)

Design Flows

1 in 3 year Exceedance Rate

Season	Criteria	Category	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
		Rainfall (in) and Days	cfs					
Dormant	Acute	0.25&2d	946	741	321	82	1	63
		0.25&3d	924	741	321	82	1	62
		0.25&4d	910	737	321	80	1	62
		0.50&2d	1400	1019	493	166	3	94
		0.50&3d	1400	1019	493	166	3	65
		0.50&4d	1400	1019	493	156	3	64
	Chronic	0.25&2d	903	734	350	88	1	63
		0.25&3d	903	734	350	88	1	62
		0.25&4d	903	734	350	87	1	62
		0.50&2d	1655	1274	697	137	2	82
		0.50&3d	1605	1274	691	132	2	80
		0.50&4d	1590	1274	637	126	2	72
Irrigation		Acute	446	173	164	10	1	20
		Chronic	481	186	179	10	1	21

Design flows based upon 7th lowest flow in 22-year flow record (1 in 3 year excursion)

Design Flows

Season/ Criteria	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
Dormant	---------- cfs ----------					
Acute	910	737	321	82	1	62
Chronic	903	734	350	87	1	62
Irrigation						
Acute	446	173	164	10	1	20
Chronic	481	186	179	10	1	21
Design flows based upon 7th lowest flow in 22-year flow record (1 in 3 year excursion)						
Design flows for acute criteria are mean daily flows						
Design flows for chronic criteria are four-day average flows						

Calculate Total Allowable Load

- Load Calculation
  - Flow (cfs)
  - Water Quality Objective (ìg/L)
  - Conversion Factor (0.0054)

TMDL (lbs) =

Flow (cfs) x WQO (ìg/L) x 0.0054

Diazinon Loads

Season/ Criteria	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
Dormant	---------- pounds/day ----------					
Acute	0.409	0.320	0.139	0.035	0.000	0.027
Chronic	0.244	0.198	0.095	0.024	0.000	0.017
Irrigation						
Acute	0.193	0.075	0.071	0.004	0.000	0.009
Chronic	0.130	0.050	0.048	0.003	0.000	0.006
Loads based upon 7th lowest flow in 22-year flow record (1 in 3 year excursion)						
Loads for acute criteria are based on mean daily flows						
Loads for chronic criteria are based on four-day average flows						

Chlorpyrifos Loads

Season/ Criteria	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
Dormant	---------- pounds/day ----------					
Acute	0.128	0.100	0.043	0.011	0.000	0.009
Chronic	0.068	0.055	0.026	0.007	0.000	0.005
Irrigation						
Acute	0.060	0.023	0.022	0.001	0.000	0.003
Chronic	0.036	0.014	0.014	0.001	0.000	0.002
Loads based upon 7th lowest flow in 22-year flow record (1 in 3 year excursion)						
Loads for acute criteria are based on mean daily flows						
Loads for chronic criteria are based on four-day average flows						

Considerations

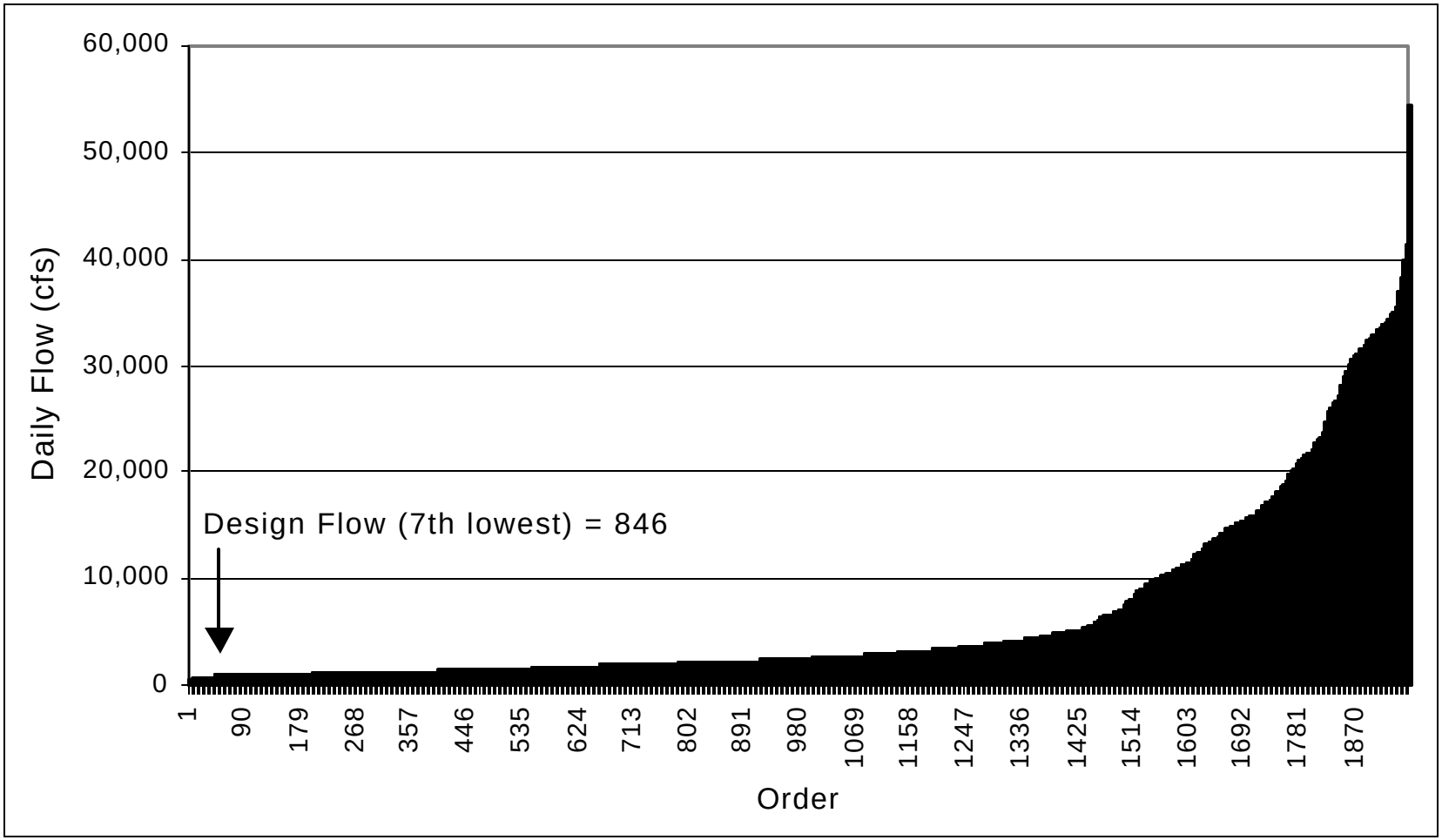
- Flow Record
- Additivity
- Seasonality

Flow Record Considerations

- 22-year flow record
  - Representative of current level of development
  - Contains critically low flow conditions
- Extended record
  - Higher flows added
  - 44-year record
  - Design flow selection not substantially changed

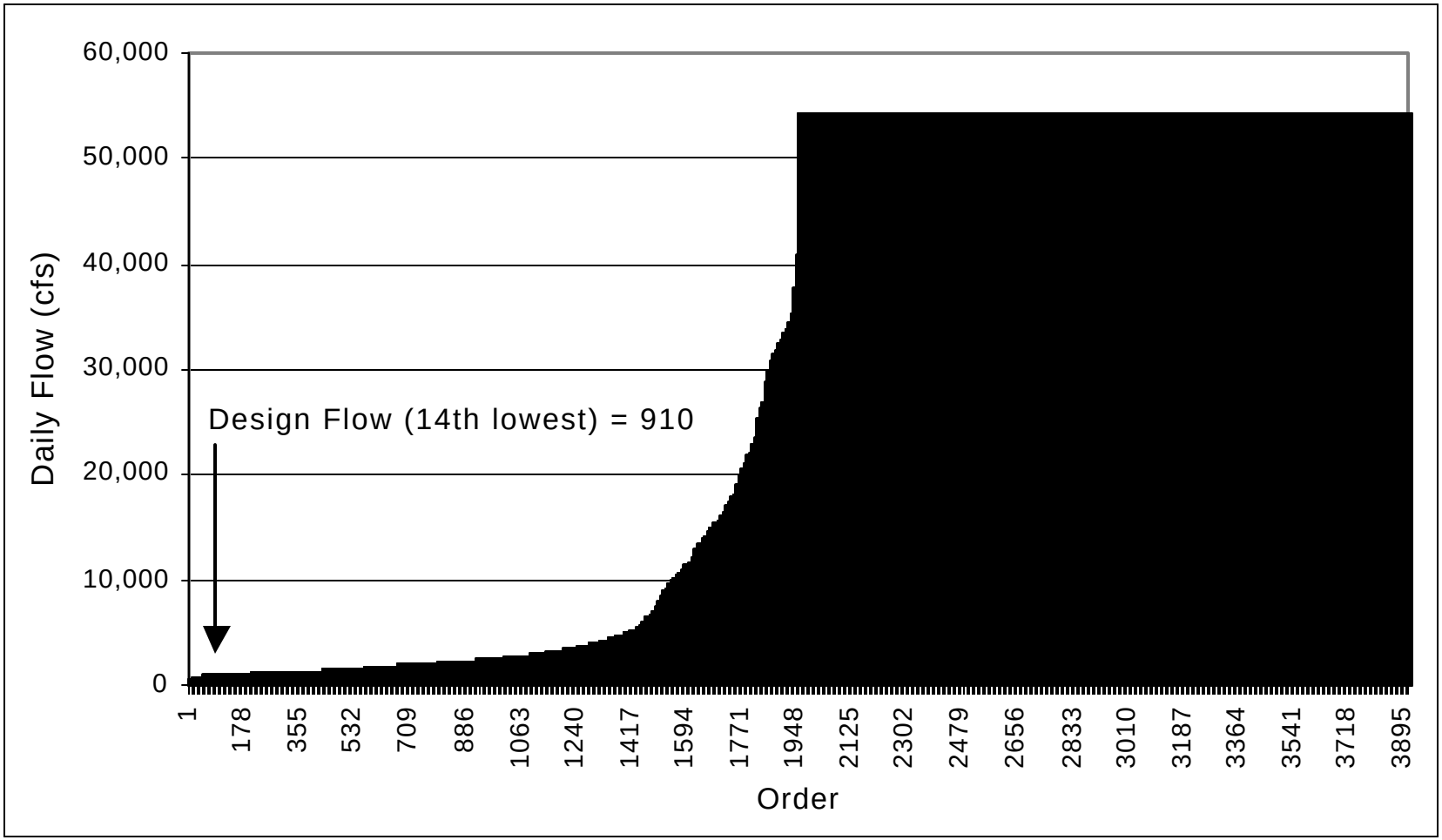
Vernalis Dormant Flows

TMDL Flow Record (22 years)



Vernalis Dormant Flows

Extended Flow Record (44 years)



Additivity Considerations

- Each pesticide load must be reduced to account for other pesticide

$$\text{Cumulative Additive Load} = \frac{\text{measured load of diazinon}}{\text{allowable load of diazinon}} + \frac{\text{measured load of chlorpyrifos}}{\text{allowable load of chlorpyrifos}} < 1.0$$

Additivity Considerations

- Allowable Pesticide Load
  - Diazinon (0.409 lbs) & Chlorpyrifos (0.128 lbs)
- Measured Diazinon Load
  - Diazinon (0.245 lbs) which is 60% of 0.409 lbs
- Allowable Chlorpyrifos Load
  - Chlorpyrifos is 40% (0.051 lbs) of 0.128 lbs

$$\text{Cumulative Additive Load} = \frac{0.245}{0.409} + \frac{0.051}{0.128} < 1.0$$

Seasonality Considerations

- Two seasons of use
- Dormant and irrigation
- 1 in 3 year excursion rate for individual seasons
- Combine both seasons
  - 1 in 6 year rate
  - Select 3rd lowest flow for design flow
  - Results in lower design flow than 1 in 3 year rate
- Continued use in both seasons limits loading capacity

Design Flows

1 in 6 year Exceedance Rate

Season	Criteria	Category	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
		Rainfall (in) and Days	---------- cfs ----------					
Dormant	Acute	0.25&2d	740	547	282	70	0	61
		0.25&3d	740	547	282	70	0	61
		0.25&4d	740	547	282	70	0	59
		0.50&2d	946	741	374	108	0	61
		0.50&3d	946	741	374	108	0	61
		0.50&4d	946	741	374	108	0	61
	Chronic	0.25&2d	880	700	325	71	0	62
		0.25&3d	877	697	325	67	0	61
		0.25&4d	873	683	325	64	0	59
		0.50&2d	1001	790	413	127	0	65
		0.50&3d	1001	790	413	124	0	65
		0.50&4d	990	790	413	124	0	65
Irrigation	Acute		405	147	145	6	0	12
	Chronic		421	157	163	8	0	19

Load Allocations

Purpose

- Allocate assimilative capacity or allowable loading to sources to meet targets in six SJR reaches

Allocations

- Background Load (BL)
  - Included in Load Allocation
- Margin of Safety (MOS)
  - Implicit in methodology
- Wasteload Allocations (WLA)
  - No point sources of pesticides
- Load Allocations (LA)

Allocations

TMDL = BL + MOS + WLA + LA

BL = Included in LA

MOS = 0

WLA = 0

TMDL = LA

Scenarios

- Current loading allocation
- Pesticide use allocation
- Geographic allocation
- Geographic with crop component allocation

Scenarios

- Current loading allocation
  - Not considered
  - Disadvantage those who have already reduced pesticide runoff through management practices
  - Insufficient data available to characterize current loading rates from all areas

Scenarios

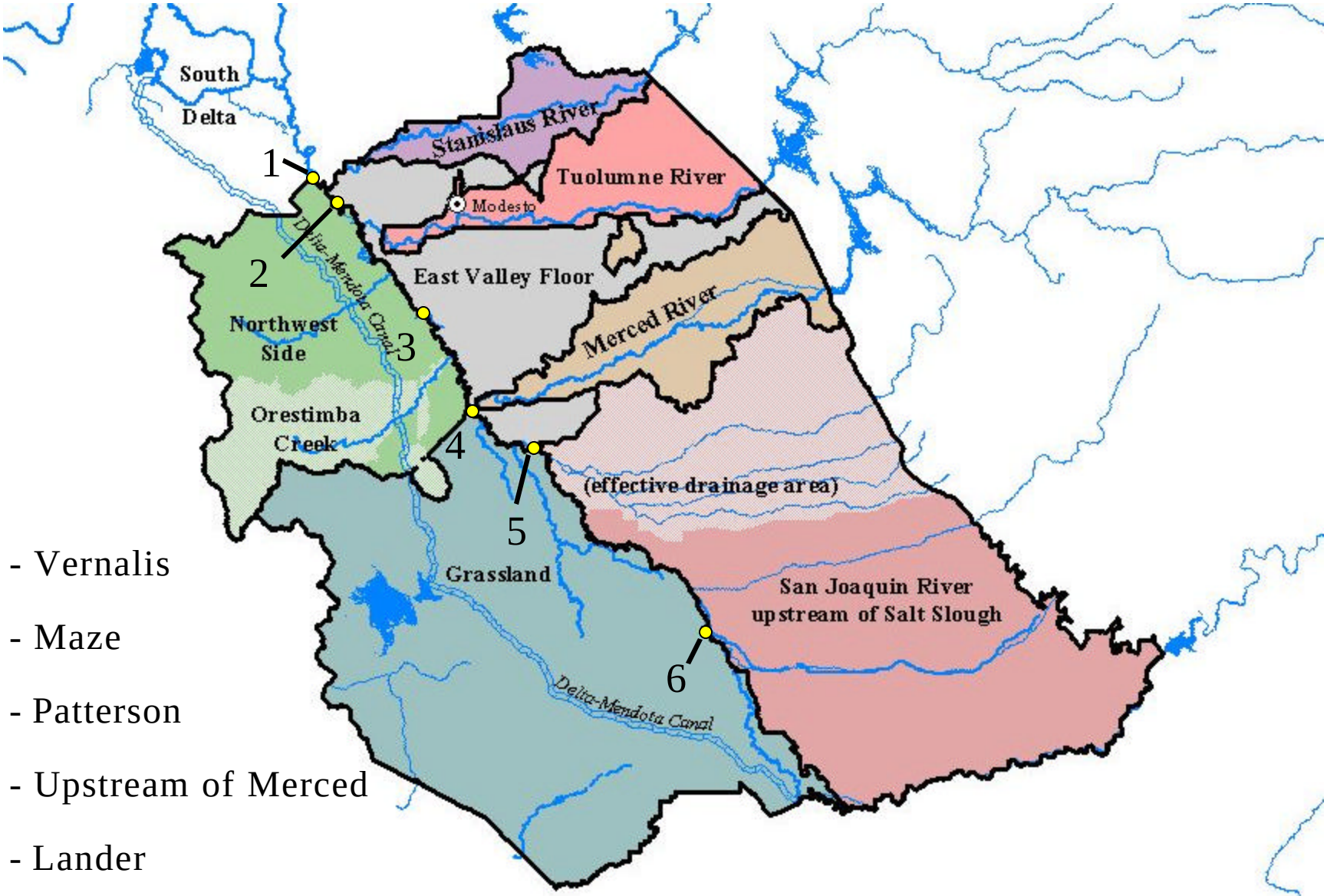
- Pesticide use allocation
  - Not considered
  - Disadvantage those who have already reduced pesticide runoff through reduced use

Scenarios

- Two scenarios considered
  - Geographic
  - Geographic with crop component
- Other considerations
  - Point of discharge
  - Allocations limited by lowest value among six reaches

Lowest Value Limitation

- Allocations calculated for each subarea according to where they contribute to flow
- Lowest allocations carried over from upstream site
- Process frees up additional allocation, which is redistributed to downstream subareas
- Redistribution based on normalized percent of remaining area, gives final limiting allocation for each subarea
- Sum of all final allocations equal to Vernalis



1 - Vernalis

2 - Maze

3 - Patterson

4 - Upstream of Merced

5 - Lander

6 - Sack

Geographic Allocation

- Assigned by subarea to receiving reaches
- Subareas calculated as percent of total basin
- Contributing upstream subareas considered for each compliance point

Subarea Contribution

Diazinon Dormant Acute

Subarea	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack	Subarea Land Area	
	---------- % ----------						mi^2	
Upstream of Salt Slough	14.3	15.0	16.1	27.8	100.0	100.0	523	523
Grassland	37.3	38.9	41.9	72.2			1,360	1,883
East Valley Floor	13.0	13.6	14.7				476	2,359
Northwest	16.5	17.2	18.6				603	2,962
Merced	7.7	8.0	8.7				281	3,243
Tuolumne	6.9	7.2					253	3,496
Stanislaus	4.2						152	3,648

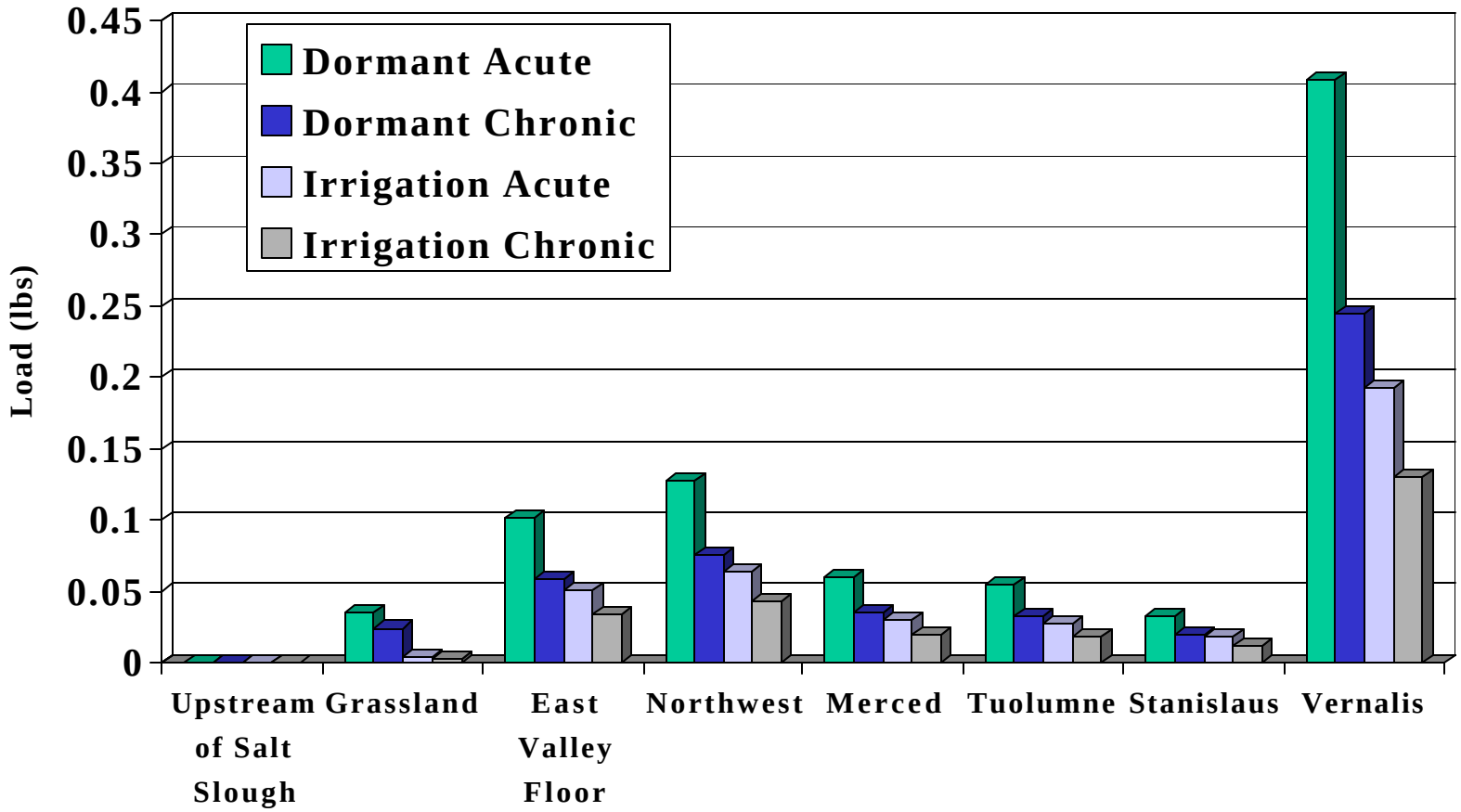
Geographic Allocation

Diazinon

Subarea	Diazinon			
	Dormant		Irrigation	
	Acute	Chronic	Acute	Chronic
	---------- pounds/day ----------			
Upstream of Salt Slough	0.000	0.000	0.000	0.000
Grassland	0.035	0.024	0.004	0.003
East Valley Floor	0.101	0.059	0.051	0.034
Northwest	0.128	0.075	0.064	0.043
Merced	0.060	0.035	0.030	0.020
Tuolumne	0.054	0.032	0.027	0.018
Stanislaus	0.032	0.019	0.018	0.012
Vernalis Allocation	0.409	0.244	0.193	0.130

Geographic Allocation

Diazinon



Considerations

- Account for seasonality
- Modify methods to allow 1 excursion in 6 years for each season
- Results in 1 excursion in 3 years for both seasons

Crop Allocations

- Assigned by subarea to receiving reaches
- Top 5 pesticide use crops selected for each pesticide, season, and subarea
- Percent of acreage of top 5 crops determined for each subarea
- Contributing upstream subareas considered for each compliance point

Top 5 Crops

Diazinon Dormant

Subarea	Almond	Peach/ Nectarine	Apricot	Apple	Prune	Total
	---------- acres ----------					
Upstream of Salt Slough	28,465	2,022	86	105	333	31,011
Grassland	5,664	94	2,027	176	998	8,959
East Valley Floor	59,568	5,393	138	1,044	0	66,143
Northwest Side	12,446	176	9,280	178	0	22,080
Merced	46,298	4,354	277	2,184	172	53,285
Tuolumne	13,437	2,433	59	324	0	16,253
Stanislaus	11,549	2,199	39	185	0	13,972
Total	177,427	16,671	11,906	4,196	1,503	211,703

Top 5 crops make up 93% of season crops

Crop Contribution

Diazinon Dormant

Subarea	Vernalis	Maze	Patterson	Upstream of Merced	Lander	Sack
	%					
Upstream of Salt Slough	14.6	15.7	17.1	77.6	100.0	100.0
Grassland	4.2	4.5	4.9	22.4		
East Valley Floor	31.2	33.5	36.4			
Northwest	10.4	11.2	12.2			
Merced	25.2	26.9	29.4			
Tuolumne	7.7	8.2				
Stanislaus	6.6					

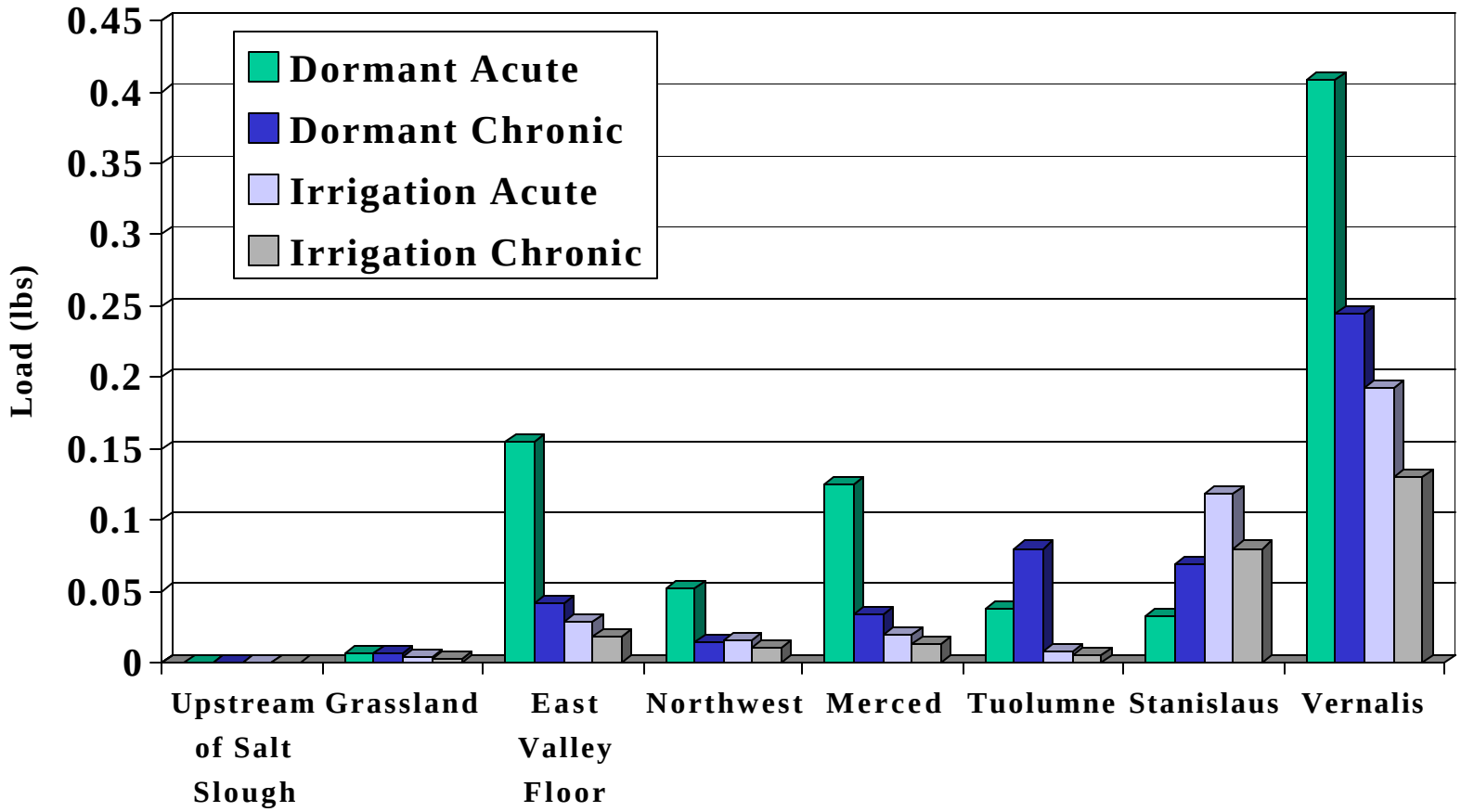
Crop Allocation

Diazinon

Subarea	Diazinon			
	Dormant		Irrigation	
	Acute	Chronic	Acute	Chronic
	---------- pounds/day ----------			
Upstream of Salt Slough	0.000	0.000	0.000	0.000
Grassland	0.007	0.006	0.004	0.003
East Valley Floor	0.155	0.042	0.028	0.018
Northwest	0.052	0.014	0.015	0.010
Merced	0.125	0.034	0.020	0.013
Tuolumne	0.038	0.080	0.008	0.005
Stanislaus	0.033	0.069	0.118	0.080
Vernalis LA	0.409	0.244	0.193	0.130

Crop Allocation

Diazinon



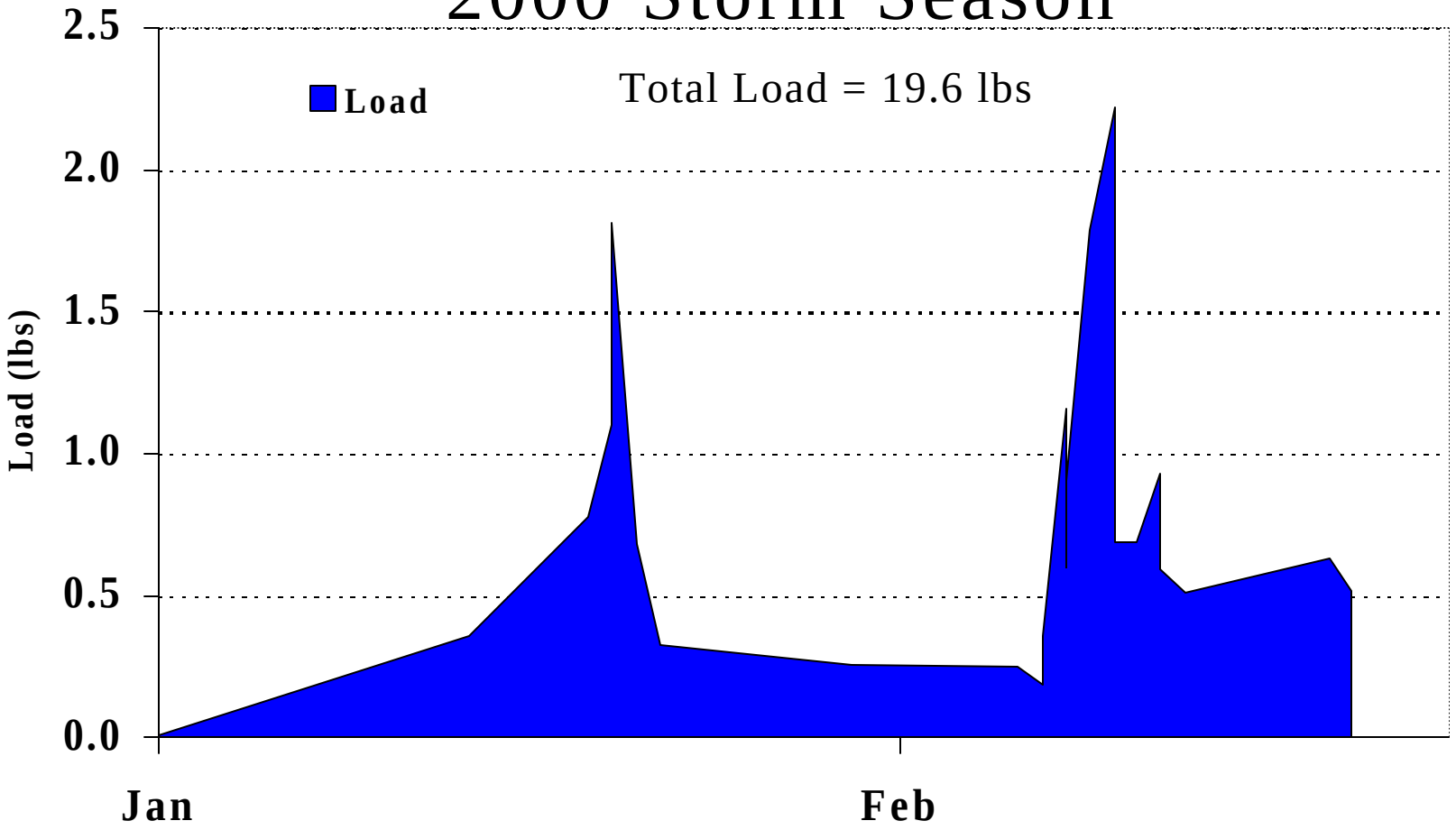
Considerations

- Account for seasonality
- Modify methods to allow 1 excursion in 6 years for each season
- Results in 1 excursion in 3 years for both seasons

Load Allocations Versus Historical Loads

- How do load allocations compare to historical loads?
- Diazinon example
  - Dormant Season
  - Irrigation season

Diazinon – SJR near Vernalis
Instantaneous Load
2000 Storm Season



Diazinon Loads
SJR near Vernalis

		Load (pounds)	
Season	Criteria	Historical	Allocation (1 in 3 year)
Dormant	Acute (daily)	2.0 (Feb 2000)	0.409
	Chronic (4-day avg)	0.5 to 1.5 (Feb 2000)	0.244
Irrigation	Acute (daily)	0.138 (May to August 2000, mean daily)	0.193
	Chronic (4-day avg)	0.138 (May to August 2000, mean daily)	0.130

Implementation Framework

Les Grober & Shakoora Azimi

Implementation Framework

- Assumptions
- Legal Authorities
- Alternatives
- Management Practices
- Monitoring

Assumptions

- Water quality objectives for diazinon and chlorpyrifos will be adopted for the San Joaquin River
- Load limits for agriculture will be established
- No urban contribution (or waste load allocations)
- Two seasons of use but no load allocation may be proposed for irrigation season
- Compliance will be monitored in the SJR (though other monitoring may be required)

Assumptions (continued)

- Basin Plan cannot compel adoption of specific methods of compliance nor compel specific action by other agencies
- A group may design a specific implementation program (and provide implementation oversight) but Regional Board would need to approve that program

Legal Authorities

- Legal authorities reviewed include:
  - Regional Water Quality Control Board
  - Dept. of Pesticide Regulation and County Agricultural Commissioners
  - U.S. Environmental Protection Agency (FIFRA)
  - Counties
  - Water Districts
  - Joint Powers Authority

Legal Authorities
Regional Water Quality Control Board

- Implements and enforces Federal and State water quality acts:
  - Clean Water Act
  - Porter Cologne
- Nine Regional Boards in the State - Central Valley Region is largest
- Basin Plan contains:
  - Water quality objectives
  - Program of implementation

Legal Authorities
Regional Water Quality Control Board

- Clean Water Act responsibilities include:
  - Issuing National Pollutant Discharge Elimination System (NPDES) permits to point sources of pollution and certain stormwater discharges
  - Developing Total Maximum Daily Loads (TMDLs) for waters not meeting standards

Legal Authorities
Regional Water Quality Control Board

- Factors considered in setting water quality objectives:
  - Beneficial uses
  - Environmental characteristics of the watershed
  - Water quality condition that could reasonably be achieved
  - Economic considerations
  - Need for housing and to develop and use recycled water

Legal Authorities
Regional Water Quality Control Board

- Program of Implementation must include:
  - Description of the nature of the actions necessary to achieve objectives
  - Time schedule for actions to be taken
  - Description of surveillance to determine compliance

Legal Authorities
Regional Water Quality Control Board
Options to Regulate Discharges

- Waste Discharge Requirements
  - Nature of the discharge are prescribed
  - Site specific or general
- Waiver of Waste Discharge Requirements
  - Requirement for WDRs may be waived if not against the public interest
  - Waivers are conditional-- may be terminated at any time
- Prohibition of Discharge
  - Regional Board can identify areas or conditions under which discharge of certain wastes is not permitted

Alternatives

- What's needed?
  - Identify regulatory mechanism (prohibition, WDR, waiver of WDRs)
  - Identify entity responsible for oversight
- Result: matrix of regulatory alternatives versus responsible entities…

Matrix of Alternatives

	Entity Responsible for Implementation Oversight			
Alternative	Regional Board	USEPA, DPR, or Ag Commissioners	Local District	Stakeholder or Other Group
Prohibition of Discharge				
WDRs				
Waiver of WDRs				

Alternatives

- Several options are being considered for each alternative; for example, a prohibition of discharge may:
  - Be conditioned upon submittal of a management plan
    - A stakeholder group or Regional Board may have responsibility of direct oversight
  - Be conditioned upon action by CDPR

Alternatives

- Evaluation criteria that will be used to develop a recommended approach
  - Feasibility
  - Time needed to implement the alternative
  - Accountability
  - Flexibility
  - Limitations on pesticide use and pest management options

Alternatives

- Evaluation criteria that will be used to develop a recommended approach
  - Certainty in meeting water quality objectives
  - Government cost
  - Grower cost
  - Registrant cost
  - Consistency with State and Federal laws and policies

Alternatives

- Current Regional Board policy for Pesticide Discharges (from Basin Plan)
  - Control of discharge achieved through implementation of management practices that minimize or eliminate discharge
  - Board will adopt prohibition or waste discharge requirements if water quality objectives violated despite DPR actions

Alternatives

- Specific alternatives will be presented at next workshop
- Staff is interested in any recommendations you have for specific implementation alternatives
- Recommendations should consider evaluation criteria
- Draft Program of Implementation Report for Control of Diazinon in the Sacramento and Feather Rivers is available on the web:
  - http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/sac_feather_diaz/index.html

Management Practices

- Overview of management practices will be presented at next workshop
- Draft Agricultural Practices and Technologies Report available on web:
  - http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/sjrop.html

Monitoring

- Porter-Cologne requires a description of the monitoring that will be done to determine compliance with objectives
- Need to establish monitoring goals in the Basin Plan
- Specific monitoring plan would be developed later

Monitoring

- Goal of monitoring is to determine:
  1. Compliance with established water quality objectives for diazinon and chlorpyrifos
  2. Compliance with established load allocations for diazinon and chlorpyrifos
  3. Degree of management practices implementation
  4. Efficacy of management practices

Monitoring

- Types of monitoring/evaluation needed to achieve goals:
  - Water quality and flow monitoring (goals 1,2,4)
  - Pesticide use evaluation (goals 2,3)
  - Monitoring adoption of improved management practices (goal 3)

Monitoring

- Water quality and flow monitoring
  - Main stem river sites (goals 1,2)
  - Tributary and subarea sites (goal 2)
  - Field scale (goals 2,4)

Other Monitoring

- Toxicity testing
- Rainfall and atmospheric deposition

Current Monitoring

- Storm season (December through February)
  - Twelve sampling sites
  - Samples are collected before, during, and after storms
- Irrigation season (March through August)
  - Weekly and biweekly sampling
  - Twenty-three sites including major tribs and small drainages

Replacement Pesticides

- Chlorpyrifos and Diazinon use have declined in recent years
- Market moving to other pesticides
- Potentially problematic:
  - Other organophosphorus pesticides
  - Carbamates
  - Pyrethroids
- Need to avoid creating new problems

Pesticides of Concern in the SJR Basin

Pesticide	Family	Main Use	Conc. At Vernalis 1993 (ìg/L)	Conc. At Vernalis 2000 (ìg/L)	Chronic Criteria (ìg/L)
Chlorpyrifos	OP	almonds, walnuts	0.04	0.007-0.105	0.014[a]
Diazinon	OP	almonds	0.6	0.01-0.0947	0.05[a]
Disulfoton	OP	urban	N/A	N/A	0.1[b]
Dachtal	OC	truck crops	0.1	N/A	20[b]
Carbaryl	CA	peaches, vineyards	0.15	0.01-0.21	0.3[b]
Eptam	CA	corn, almonds	0.1	0.002-0.009	0.19[b]
Cyanazine	TR	cotton, corn	0.12	0.004-0.017	3[b]
Simazine	TR	almonds, vineyards	0.3	0.02-3.76	4[b]
Methidathion	OP	peaches, fruit trees	N/A	N/A	5.1[b]
Pyrethroids	Pyrethroids	peaches, fruit trees	N/A	N/A	
Bifenthrin					0.02[b]
Cyfluthrin					0.01[b]
Cypermethrin					0.43[b]
Cyhalothrin					0.37[b]
Esfenvalerate					0.19[b]

Please see next slide for footnotes.

Pesticides of Concern

Footnotes

OP -- organophosphorus; TR -- triazine; CA -- carbamate;

I -- insecticide; AM -- amide; MI – miscellaneous.

OC – organochlorine.

MDL: limit of detection. LOQ: limit of Quantitation.

GC/MS -- gas chromatography/mass spectrometry.

(A) chronic criteria DFG study using EPA method.

(B) US EPA ECOTOX database.

LOQs for Pyrethroid is based on individual compound.

Next Steps

- Draft Program of Implementation Report:
  - Late August workshop
- Draft Basin Plan Amendment staff report:
  - Beneficial uses
  - Water quality objectives
  - Program of implementation
  - TMDL elements (loading capacity, allocations, margin of safety)
  - Surveillance and monitoring

How You Can Contribute

- Provide feedback on:
  - TMDL Report (comments by 23 August)
  - Draft Program of Implementation (provide ideas on implementation alternatives)
  - Participate in Draft Basin Plan Amendment Workshops (December and March)

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